QUALITY ASSURANCE PROJECT PLAN FOR PRE-REMEDIAL/PRE-REMOVAL SITE ASSESSMENT

REVISION 4
SEPTEMBER 30, 2004

Prepared by the
Missouri Department of Natural Resources
Air and Land Protection Division
Hazardous Waste Program
Superfund Section

Department of Natural Resources
P.O. Box 176
Jefferson City, Missouri 65102-0176

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QUALITY ASSURANCE APPROVALS

US EPA Region VII
QA Manager_____
Signature Date

US EPA Region VII Site
Assessment Manager_____
Signature Date

ALPD QA Manager_____
Signature Date

PROGRAM APPROVALS

HWP SAU QA
Project Officer_____
Signature Date

HWP SAU QA
Project Officer_____
Signature Date

HWP Director_____
Signature Date

ESP Director_____
Signature Date

A2. Distribution List

Missouri Department of Natural Resources (MDNR)

John Madras - Quality Assurance QA) Manager, Environmental Policy Director, Air and Land Protection Division (ALPD)

Hazardous Waste Program (HWP)
Ed Galbraith - Acting Director
Dennis Stinson – Chief, Superfund Section
Julieann Warren – Chief, Site Assessment Unit (SAU), Superfund Section
Valerie Wilder & Michael Stroh – Environmental Specialists (ES) III, SAU, Superfund Section

Environmental Services Program (ESP)
Earl Pabst – Director
Connie Giesing – Chief, Chemical Analysis Section (CAS)
Brian Allen – Chief, Superfund/Resource Conservation and Recovery Act (RCRA) Unit, Field Sampling Section (FSS)
Eric Sappington – Environmental Specialist, FSS
Jane Davis - Quality Assurance Project Plan (QAPP) Coordinator

U.S. Environmental Protection Agency (EPA)

Diane Harris, Region VII Quality Assurance Manager
Jamie Bernard-Drakey, Region VII Site Assessment Manager

A3. Project/Task Organization

The following list identifies key individuals and organizations participating in the project, and discusses their specific roles and responsibilities as they pertain to this QAPP.

Project Mangement Staff of SAU, Superfund Section, HWP, ALPD, MDNR

Role: Site Project Managers, SAU, HWP, ALPD, MDNR

Responsibilities: Overall management of site assessment projects. Coordinate all site-specific activities related to conducting the site assessment investigations including correspondence, communication and scheduling. Conduct sample collection by appropriate methods to provide data of sufficient quality. Prepare site assessment reports ensuring that site-specific activities conducted pursuant to this QAPP meet project Data Quality

Objectives (DQOs).

Valerie Wilder and Michael Stroh, ES III, SAU, HWP, ALPD, MDNR

Role: QA Project Officer (shared duty)

Responsibilities: Prepares the QAPP and subsequent revisions, and ensures that the most current revision is available to all staff. Ensure that hardcopy and electronic versions of the QAPP are maintained and available to all Unit staff. Assists in the development of project DQOs and project sampling plans. Review data collected and resolve QA issues that arise. Evaluate analytical data to ensure that DQO are met. Utilize the data collected to complete site assessment and characterization and/or to evaluate remediation objectives. Review and approve all project and Quality Assurance/Quality Control (QA/QC) data. Ensures that all QA requirements of the QAPP are met. Coordinate overall project activities.

Julieann Warren, Chief, SAU, HWP, ALPD, MDNR

Roles: HWP QA Coordinator and Supervisor, SAU

Responsibilities: As HWP QA Coordinator, serves as the program's point of contact on all QA issues. Coordinates all QA activities for the program. Provides QA/QC information and reviews all HWP QA/QC activities. Informs QA Manager of all program QA needs, problems, and status. Assists in the completion of the QA status reports to the EPA. As Supervisor of SAU, reviews the data and validates that the project DQOs are met. Assists as appropriate in the performance auditing of all activities performed by the HWP and contractual staff.

Environmental Specialist Staff of Superfund/RCRA Unit, FSS, ESP, ALPD, MDNR

Role: Field Staff, Superfund/RCRA Unit, FSS, ESP

Responsibilities: Prepare and implement site specific sampling plans to collect environmental samples according to ESP FSS Starndard Operating Procedures (SOPs) at potential and/or confirmed abandoned and uncontrolled hazardous waste sites. Conduct sample collection by appropriate methods to provide data of sufficient quality. Prepare and implement health and safety plans for investigations conducted by the Department at potential and/or confirmed abandoned and uncontrolled hazardous waste sites. Prepare formal reports of sampling investigations for SAU staff to evaluate and include in site assessment reports.

Brian Allen, Chief, Superfund/RCRA Unit, FSS, ESP, ALPD, MDNR

Role: Chief, Superfund/RCRA Unit, FSS, ESP

Responsibilities: Supervises field staff conducting investigations and assists in scheduling

their activities. Assures staff are qualified and trained to perform the work, familiar with the required SOPs, including those related to QA/QC, and have the equipment necessary to perform the work. Reviews reports of investigation for completeness, clarity, and accuracy.

Eric Sappington, ES IV, ESP, ALPD, MDNR

Role: QA Field Auditor, FSS, ESP

Responsibilities: Performs field audits of ESP staff who conduct investigations in order to verify that staff is following the ESP SOPs for environmental data collection. Prepares audit reports summarizing procedures used and makes recommendations for improvement.

Connie Giesing, Chief, CAS, ESP, ALPD, MDNR

Role: Supervisor, CAS, ESP

Responsibilities: Ensures that appropriate analytical methods, CAS SOPs, QC procedures, documentation, and training are implemented and routinely followed by all supervisory and technical staff of the CAS. Utilizes data review checklists and QC charts for both precision and accuracy data in the data quality review process. Conducts reviews of data files following review and approval by staff at the unit chief level.

Earl Pabst, Director, ESP, ALPD, MDNR

Role: Director, ESP

Responsibilities: Ensures overall validation and final approval of data generated by the ESP. Assists as appropriate in the performance auditing of all activities performed by ESP personnel.

John Madras, Environmental Policy Director, ALPD, MDNR

Role: ALPD QA Manager

Responsibilities: Monitors the overall QA operations for the division. Develops and maintains the Quality Management Plan (QMP). Reviews and approves all QAPPs for the division. Prepares QA status reports to the EPA.

Jamie Bernard-Drakey, Site Assessment Manager, Enforcement/Fund Lead Removal Branch, Superfund Division, EPA Region VII

Role: Project Officer, EPA Region VII

Responsibilities: Review and final acceptance and approval of the project and system auditing. Reviews and approves all final documents to ensure project integrity is maintained.

Has final authority for the project decisions.

Diane Harris, QA Manager, EPA Region VII

Role: EPA Region VII QA Manager

Responsibilities: Reviews and approves QAPPs developed for projects conducted under the Superfund Consolidated Cooperative Agreement in accordance with 40 CFR Part 35, Subpart O.

A4. Project Definition/Background

A4.1 Project Background

Site assessment is the initial phase of the Superfund response program. It is the process by which EPA and the states identify, evaluate, and rank hazardous waste sites. The objectives of the site assessment program are: to assist the EPA in screening sites prior to entry into the EPA inventory of potential waste sites known as the CERCLA Information System (CERCLIS); to evaluate sites already listed in CERCLIS; and to identify candidate sites for removal actions and remedial actions under the federal Superfund law. Potential uncontrolled hazardous substance sites continue to be discovered and investigated. Releases are discovered by different methods, including investigations by governmental authorities, notification by permit holders, citizen complaints, CERCLA 103 notifications, and other sources. The SAU of the Superfund Section of the MNDR conducts pre-remedial/pre-removal site assessments with funding through a Superfund Consolidated Cooperative Agreement negotiated annually between the EPA Region VII and MDNR. This QAPP covers environmental data acquisition activities pursuant to conducting site assessments under CERCLA authority.

A4.2 Project Definition

Site assessment activities help identify and evaluate the most serious hazardous waste sites. There are several different types of site investigations that are performed within the site assessment process. The following is a list of the basic types of investigations in the general order in which they would occur: Desk Top Review (DTR), Pre-CERCLIS Site Screening (Pre-CERCLIS SS), Preliminary Assessment (PA), Site Inspection (SI), Expanded Site Inspection (ESI), Hazard Ranking System (HRS) Scoring. Combining the Preliminary Assessment and Site Inspection (PA/SI) are encouraged, if appropriate, to streamline the site assessment process and reduce tasks to one continuous site investigation. Removal Assessments (RA) are another type of investigation that can be performed during the site assessment process. Integrating RAs with remedial site assessments is also encouraged to speed the site evaluation process and save resources. A Site Reassessment (SR) is another type of investigation that can be conducted during the process. At each stage in the site assessment process, sites are subject to one of several outcomes: further assessment under CERCLA, referral to the removal program, referral to other non-CERCLA authorities, or a decision for no further action under CERCLA.

This QAPP is generic in the sense that it applies to several different projects and project types, and is ongoing in that the projects are conducted continuously with funding from the Superfund Consolidated Cooperative Agreement. Specific workplans for project work to be conducted during each state fiscal year are prepared annually as separate documents.

This QAPP will be reviewed and revised annually as needed.

A4.2.1 Desk Top Review

DTRs involve the review of available information, including file reviews and checking with other programs and agencies to see whether the site has been or is currently being handled by another program or authority. The review may include an assessment of existing analytical data. A decision on whether that site needs further investigation by SAU is documented in a one-page form.

A4.2.2 Pre-CERCLIS Site Screening

Once a potential hazardous waste site has been brought to the attention of the SAU, a Pre-CERCLIS SS investigation will be initiated. The purpose of this investigation is to determine whether the site meets CERCLA eligibility criteria, and warrants entry onto CERCLIS. A site warrants entry onto CERCLIS if there is a release of a hazardous substance into the environment, or a substantial threat of such a release, which may present a danger to human health or the environment. Typically a site visit and limited environmental sampling is conducted as part of the Pre-CERCLIS Site Screening investigation. The department conducts SS investigations and provides recommendations to EPA, who makes the determination on whether to enter them on CERCLIS. The further assessment activities described in A4.2.3 through A4.2.9 may only be conducted for sites that have been entered on CERCLIS.

A4.2.3 Preliminary Assessment

Once a site has been determined to meet CERCLA eligibility, and has been entered into CERCLIS, the SAU will initiate a PA investigation to assess the threat posed by the site to human health and the environment. The objectives of a PA are to eliminate from further consideration those sites that pose no significant threat to public health or the environment; determine if there is any potential need for removal action; set priorities for further investigation under CERCLA; and gather existing data to facilitate later evaluation of the release pursuant to the HRS. The scope of a PA generally includes a review of existing information about a release such as information on the pathways of exposure, exposure targets, and source and nature of the release and a site reconnaissance. A narrative report is prepared that includes conclusions, recommendations as to whether further investigation or response action is warranted, and the relative priority. A draft HRS score may or may not be generated depending upon available data.

A4.2.4 Site Inspection

SI are conducted at sites where a PA has determined that further investigation is warranted. The SI should build upon the information collected in the PA. The objectives of an SI are to eliminate from further consideration those releases that pose no significant threat to public health or the environment; determine the potential need for a removal action; collect or develop additional data, as appropriate, to evaluate the release pursuant to the HRS; and collect data in addition to that required to score the release pursuant to the HRS, as appropriate, to better characterize the release

for more effective and rapid initiation of further CERCLA investigation or response under other authorities. The scope of an SI generally includes collecting source samples to determine types and concentrations of hazardous substances onsite and collecting media samples to investigate migration of hazardous substances from the site. The sampling data is used to generate a preliminary HRS score to determine if the site qualifies for placement on the National Priority List (NPL). A narrative report is prepared that includes conclusions, recommendations as to whether further investigation or response action is warranted, and the relative priority.

A4.2.5 Combined Assessment

Combined PA/SIs are conducted to streamline the site assessment process, formulating and testing hypotheses regarding the site and producing one report combining both PA and SI activities. Combined PA/SIs are conducted at sites when it is suspected at an early stage that information beyond the scope of a traditional PA will be needed. The combined PA/SI assessment integrates activities typically performed during the PA (information gathering, initial site reconnaissance, limited sampling) with activities typically performed during the SI (review of data, further field sampling, filling data gaps, evaluating site relative to the HRS) to achieve one continuous site investigation. A narrative report is prepared that includes conclusions, recommendations as to whether further investigation or response action is warranted, and the relative priority.

A4.2.6 Removal Assessment

RA are conducted to assess the immediate hazards a site poses to human health and the environment. The purpose of an RA is to determine whether a removal action (emergency, time-critical or non-time-critical) is warranted in response to a release at the site. There are eight removal criteria that are evaluated in order to determine whether a removal action is warranted. A brief narrative Removal Assessment Report and Superfund Removal Site Evaluation and Removal Preliminary Assessment Form are prepared.

A4.2.7 Integrated Assessment

An Integrated Assessment is one that combines a pre-remedial assessment with a RA and takes into consideration the goals of both the removal and remedial programs. This differs from a combined assessment where steps within one program are consolidated for greater efficiency. Site assessment elements such as the Pre-CERCLIS SS, PA, SI, Combined PA/SI, or ESI may be integrated with the RA at any time in the site assessment process to increase efficiency. Examples of integrated assessments include Pre-CERCLIS Site Screening/Removal Assessment (SS/RA), Preliminary Assessment/Removal Assessment (PA/RA), Site Inspection/Removal Assessment (SI/RA), and Preliminary Assessment/Site Inspection/Removal Assessment (PA/SI/RA). A narrative report and a Superfund Removal Site Evaluation and Removal Preliminary Assessment Form are prepared that includes conclusions, recommendations as to whether further investigation and/or a removal action is warranted, and the relative priority.

A4.2.8 Expanded Site Inspection

An Expanded Site Inspection will generally only be conducted at those sites that are being considered as candidates for the NPL. A site will generally not progress to this stage if the PA/SI investigation does not identify with certainty that the site would be eligible for the NPL with the collection of the additional data, or unless the EPA Region VII concurs that an ESI is necessary to

determine a final disposition under CERCLA. The objectives of an ESI are to determine whether the site is eligible for listing on the NPL by expanding on existing information and data gathered during the SI to evaluate the release pursuant to the HRS; determine the potential need for a removal action; and collect additional data to better characterize the release for more effective and rapid initiation of further CERCLA investigation or response under other authorities. A narrative report is prepared that includes HRS score sheets and a recommendation as to whether an HRS Scoring Package should be prepared and whether the State of Missouri supports listing the site on the NPL.

A4.2.9 Site Reassessment

A Site Reassessment is a pre-remedial investigation that may be performed on sites that warrant further investigation after an initial CERCLA site investigation has been performed, but do not warrant an ESI, or on sites where new information has become available that may affect findings of previous investigation(s). A SR is performed on those sites that are not candidates for the NPL, but that require further investigation in order to make a final recommendation for action. These sites will generally require supplemental sampling with a level of effort equivalent to a Pre-CERCLIS Site Screening. A brief summary SR Report is prepared.

A4.3 Project Output

Results of each site assessment project will be documented in a site assessment report prepared by the SAU Project Manager. The title, organization, and content of the reports will vary with the type of site assessment conducted. These are described in MDNR-SAU-100 "Writing Pre-CERCLIS Site Assessment Reports", and MDNR-SAU-101 "Writing Site Assessment Reports". Where site scoring is applicable, draft HRS scores will be prepared using *The Hazard Ranking System Guidance Manual* (U.S. EPA, 1992b), and the latest versions of the QuickScore and SuperScreen computer programs.

A5. Project/Task Description

A5.1 Task Description

The tasks included in projects addressed by this QAPP can be grouped into the following general categories: site reconnaissance, sample collection, sample analysis, data verification and validation, documentation and reporting, and auditing. The various tasks in these categories are briefly described below.

A5.1.1 Site Reconnaissance

At the beginning of each project, SAU personnel will conduct a site reconnaissance for the purposes of identifying contaminant source area(s), evaluating potential exposure pathways, conducting a target survey, and verifying planned sample locations by examining the site and its surroundings. Specific tasks of site reconnaissance include creating a site sketch, collecting site photographs, collecting locational data, conducting interviews, collecting source and target information, and documenting findings both in a field notebook and a formal reconnaissance memo. Personnel from ESP and/or the Geological Survey and Resource Assessment Division (GSRAD) may be requested to accompany SAU staff on site reconnaissance visits to assist in these tasks. All field activities and public contacts will be coordinated through the SAU.

A5.1.2 Sample Collection

Projects conducted under this QAPP will generally require the collection of site samples from environmental media. The media to be sampled will vary based on site-specific conditions, and may include: waste materials, surface and subsurface soil, groundwater, surface water, sediment, air, and surfaces (wipe samples). Other media may require sampling on a site-specific basis.

Based on available site information, and data gathered during the site reconnaissance, the SAU Site Project Manager will prepare a sampling request memo to ESP. The memo will provide general site background information, describe the number, type, and location of samples to be collected, along with analytical parameters requested for each sample. The SAU Site Project Manager will use the DQO process described in Section A6 of the QAPP to develop the sampling request memo. Based on the sampling request memo, ESP will prepare and implement a sampling plan. Sample collection is typically conducted by ESP personnel, with on-site oversight by the SAU Site Project Manager. However, for some projects with limited sampling needs, SAU will conduct sampling independently. Further details about sample collection are provided in Sections B1 through B3.

A5.1.3 Sample Analysis

Samples collected for projects under this QAPP will be submitted to the ESP CAS for laboratory analysis. The CAS will conduct sample analysis using standard EPA testing methods, and provide analytical results to SAU. The analytical parameters requested will vary by project. Further information about sample analysis is provided in Section B.

On-site field screening analyses may be conducted by the ESP or the SAU when a variety of unknown materials or media are present on-site, or when field screening analyses could result in significant economies in laboratory analytical work.

A5.1.4 Data Verification and Validation

In general, data verification and validation are performed by the staff and supervisors of ESP FSS and CAS. Further data validation is conducted by the SAU Project Manager during review of the reports generated by ESP, and by the SAU QA Project Officer during review of the final project report. Data verification and validation methods are as described in ESP FSS and CAS SOPs. Data quality assessment is conducted by the SAU Site Project Manager together with the SAU QA Project Officer and HWP QA Coordinator. The EPA Site Assessment Manager, as the data user, will make the final determination of whether the validated data support the decisions/recommendations made in the project report. Details on validation, verification, and data quality assessment process are provided in Section D.

A5.1.5 Documentation and Reporting

Documentation and reporting tasks are completed at various steps along each project's duration. Notes from the site reconnaissance and sampling events are recorded in a field notebook, and formalized in a site reconnaissance memo (prepared by SAU) and a sampling report (prepared by ESP). A sampling request memo is prepared by SAU outlining the sampling to be conducted. A sampling plan and health and safety plan are prepared by ESP and approved by SAU. Following sample analysis, CAS provides analytical data reporting sheets to SAU containing sample results.

The sample collection event is summarized in a sampling report prepared by ESP. Summary reports are prepared by ESP following audits of both laboratory and field sampling performance. Further information on documenting and reporting is provided in each of the following main sections of the QAPP.

A5.1.6 Auditing

Periodic auditing is done both of laboratory performance and field activities. The CAS participates in semi-annual round robin audit studies that provide all of the EPA and National Environmental Laboratory Accreditation Conference (NELAC) requirements for laboratory QC programs. ESP conducts annual field QA audits of each staff member conducting sample collection for projects included in this QAPP. The audits are coordinated and conducted by ESP, and a summary report will be provided to SAU. Further information on auditing is provided in Section C.

A5.2 Special Equipment and Services

Many of the projects initiated under this QAPP will require the use of special equipment and/or services. Where used, this equipment and services will be fully described in the project sampling plan. A brief description of this equipment and services along with information on how they will be implemented is provided below.

A5.2.1 Excavation and Well Installation

The SAU will identify the need to perform limited excavation at sites to obtain samples of buried material or to document other subsurface conditions. The SAU will also identify the need for installation of any permanent or temporary monitoring wells. The ESP will manage the procurement, selection, and oversight of contractual services for excavation or installation work using procedures acceptable for expenditure of federal funds. The ESP will involve the SAU in concurrence of scopes of work, Requests for Proposals (RFP), and other procurement documents and will involve the SAU in contractor selection.

A5.2.2 Hydraulic Subsurface Probe

It is estimated that 80 percent of the site assessment investigations involving sampling will require the use of a Geoprobe®. Depending on availability, either a Geoprobe® stored at the ESP or at the GSRAD will be used for these sites. The ESP field personnel will be responsible for all field activities involving the collection of samples, including decontamination procedures and disposal of investigation derived wastes.

A5.2.3 Geophysical Investigation Equipment

The SAU will identify the need to conduct geophysical surveys at sites where buried wastes are suspected. The types of geophysical survey methods that may be used include magnetic, resistivity, electromagnetic, ground penetrating radar, seismic reflection/refraction, tomography, 2-d and 3-d surveys. When appropriate, use of the GSRAD OhmMapper, a geophysical resistivity meter, may be requested. GSRAD personnel will be responsible for use of the OhmMapper and for providing a report of results to the SAU. If other or additional geophysical surveys are necessary, ESP will manage the procurement, selection, and oversight of contractual services for such survey work using procedures acceptable for expenditure of federal funds. The ESP will involve the SAU in concurrence of scopes of work, RFPs, and other procurement documents and will involve the SAU

in contractor selection.

A5.2.4 Global Positioning System

The SAU will request the ESP to collect Global Positioning System (GPS) readings for all sites. The readings should include one locational point for the general site position and a reading for each sample collection point. All GPS points should be collected in accordance with *Locational Data Method Accuracy Description,* (MDNR, 1999). The GPS readings will be used to create Geographic Information System (GIS) site maps using ARCGIS®.

A5.2.5 X-Ray Fluorescence Detector (XRF)

The SAU will identify the need to conduct screening of site samples for specific metals using the HWP's XRF spectrum analyzers. The SAU may conduct XRF screening independently or they may request that ESP screen soil samples from a site using one of the three following methods: in-situ screening, screening samples collected and homogenized in plastic bags, or screening fully prepared samples (ground, sieved and placed in sample cups). Analysis of soil and sediment samples with the XRF will be conducted in accordance with the manufacturer's users guide and applicable EPA SW-846 methods.

A5.2.6 Other Field Screening

The SAU may request that ESP conduct field screening tests for specific contaminants (besides those metals detected with the XRF) utilizing technologies and equipment such as the Membrane Interface Probe (MIP), portable Gas Chromatography-Mass Spectrometry, immunoassay test kits, colorimetric tubes, soil gas surveys, and others. SAU will coordinate and discuss with ESP when, how and what field screening tests will be used. Generally, ESP will be requested to manage the procurement and use of such field screening tests.

A5.3 Project Scheduling

This QAPP covers the field and analytical activities related to CERCLA pre-remedial/pre-removal site assessment. This ongoing project is funded under consecutive Superfund Consolidated Cooperative Agreements that are periodically negotiated between EPA Region VII and the MDNR. As this project is ongoing, the QAPP is designed to continue in effect indefinitely. The QA Project Officers will review the QAPP at least once a year, and will provide any significant changes in the content of the QAPP for EPA approval. This annual QAPP review will be completed no later than August 15th of each year.

The SAU will conduct biannual planning meetings with ESP and GSRAD personnel to provide information regarding sites where sampling will be necessary, and begin scheduling of field activities. A description of the types of services anticipated to be requested from the ESP FSS along with the estimated volume of these services is provided in a workplan prepared between the HWP and ESP annually. A list of the estimated number and type of laboratory analyses anticipated to be requested from the ESP CAS are provided in a workplan between the HWP and ESP prepared annually.

A6. Systematic Planning Process (Data Quality Objectives)

DQOs are qualitative and quantitative statements derived from the Systematic Planning and DQO processes developed by EPA and further described in *Guidance for the Data Quality Objectives Process* (U.S. EPA, 2000c), and *Data Quality Objectives Process for Hazardous Waste Investigations* (U.S. EPA, 2000a). The DQO process is the Systematic Planning Process used to develop this QAPP. The DQO process is an iterative, strategic planning approach designed to ensure that the type, quality, and quantity of environmental data used in decision making are appropriate for the intended application. The following section describes general DQOs applicable to all site assessment activities covered by this QAPP. Some of the following DQOs will have site-specific elements that will be developed and documented on a site-by-site basis. Generally, this will occur during preparation of the sampling plan.

A6.1 Problem Statement

A6.1.1 Background Information

Historical and background information relevant to the general process of pre-remedial/pre-removal site assessment is presented in section A3. When available, a summary of background information specific to each site assessed under this QAPP will be provided by SAU to ESP at the beginning of each site assessment project.

A6.1.2 Conceptual Site Model

For each site assessed under this QAPP, a Conceptual Site Model (CSM) will be prepared by the SAU Site Project Manager using the background information available for the site together with applicable guidance documents including; *Improving Site Assessment: Pre-CERCLIS Screening Assessments* (U.S. EPA, 1999b), *Guidance for Performing Preliminary Assessments Under CERCLA* (U.S. EPA, 1991a), *Guidance for Performing Site Inspections Under CERCLA* (U.S. EPA, 1992a), *The Hazard Ranking System Guidance Manual* (U.S. EPA, 1992b), and the various EPA fact sheets available on site assessment. The CSM will be included as part of the sampling request memo to ESP, and incorporated into the sampling plan.

The conceptual site model is a functional description of the potential contamination problem. The CSM is often accompanied by a CSM diagram that illustrates the relationships among:

- Contaminant sources (primary and secondary) and release mechanisms (primary and secondary);
- Migration pathways (e.g. wind, groundwater, sediments, surface water);
- Exposure routes (e.g. ingestion, inhalation, direct contact); and
- Human and ecological receptors.

An example CSM diagram in included as Appendix 1. A complete and detailed CSM is essential to making sound professional judgements regarding sampling design. The SAU will prepare a CSM that consists of a narrative description of the contamination and/or the CSM diagram. When preparing Sampling Plans for the majority of site assessment investigations, a judgmental sampling design will be utilized (see Section A6.7). This design is based on knowledge of site conditions. It is distinguished from probability-based sampling in that inferences are based on professional judgement, not statistical theory. Therefore, conclusions drawn using this type of design depend entirely on the validity and accuracy of professional judgement. Since the professional judgement is based largely on the CSM of the site, developing a good CSM is a critical step in the DQO

process.

When developing a CSM for a judgmental sampling design, the following site information should be considered: soil properties that affect contaminant migration, physical and chemical nature of contaminants, the manner in which contaminants are understood to have been released, timing and duration of the release, amount of contaminants understood to have been released.

It is important to note that for some site assessments conducted under this QAPP, particularly Pre-CERCLIS SS investigations, the development of a detailed conceptual site model may be difficult due to lack of available background/historical information.

A6.1.3 Available Resources and Constraints

The Superfund Consolidated Cooperative Agreement is negotiated annually between the EPA Region VII and MDNR in order to determine the number of staff and funding available for pre-remedial activities outlined in this QAPP. The current Cooperative Agreement provides funding for no less than seven Full Time Employees (FTEs) in the SAU, two FTE at the ESP and 1 FTE at the GSRAD for the purpose of conducting site assessment activities.

The average level of effort in staff time required for each type of investigation is listed in the table below. The relevant schedule and deadline for conducting and completing each site assessment investigation varies on a site-by-site basis depending on factors such as the nature of the site, MDNR priorities, public concern, availability of equipment, etc.

Table 1. Estimated Level of Staff Time Required by Project Type

PROJECT TYPE	ESTIMATED NUMBER OF HOURS TO COMPLETE
Pre-CERCLIS Site Screenings	100
Site Reassessments	185
Preliminary Assessment	225
Site Inspections	470
Expanded Site Inspection	900
Removal Assessment	300
Combined PA/SI	560
Integrated PA/RA	355
Integrated/Combined PA/SI/RA	575
Integrated SI/RA	600

A6.2 Decision Statements

The goals of various site assessment investigations conducted under this QAPP may be slightly different. Therefore, separate decision statements for each investigation type have been prepared.

A6.2.1 Pre-CERCLIS Site Screening Investigation

The decisions to be made from this investigation are:

- Determine whether the site is eligible for entry onto CERCLIS.
- Determine whether to recommend the site for entry onto CERCLIS.
- Determine whether there is any potential need for a removal action.
- Determine whether to recommend a removal action.

A6.2.2 Preliminary Assessment

The decisions to be made from this investigation are:

- Determine whether further assessment under CERCLA is warranted.
- Determine whether to recommend further CERCLA assessment for sites that warrant it.
- Determine the priority for further CERCLA investigation for those sites that are recommended for such.
- Determine whether there is any potential need for a removal action.

A6.2.3 Site Inspection

The decisions to be made from this investigation are:

- Determine whether further assessment under CERCLA is warranted.
- Determine whether to recommend further CERCLA assessment for sites that warrant it.
- Determine the priority for further CERCLA investigation for those sites that are recommended for such.
- Determine whether there is any potential need for a removal action.
- Determine a site score using the HRS.

A6.2.4 Expanded Site Inspection

The decisions to be made from this investigation are:

- Determine whether the site warrants proposal for listing on the NPL.
- Determine whether to recommend proposal of the site for listing on the NPL.
- Determine whether there is any potential need for a removal action.

A6.2.5 Removal Assessment

The decisions to be made from this investigation are:

- Determine whether a removal action is warranted and if so, what type (emergency, time-critical, or non-time critical).
- Determine whether to recommend the site for a removal action.

A6.2.6 Combined PA/SI Assessment

The decisions to be made from this investigation are the same as those outlined under Sections A6.2.2 Preliminary Assessment and A6.2.3 Site Inspection.

A6.2.7 Integrated Assessments

The decisions to be made from this investigation are the same as those outlined under Sections A6.2.1 Pre-CERCLIS Site Screening, A6.2.2 Preliminary Assessment and A6.2.3 Site Inspection, A6.2.4 Expanded Site Inspection, and A6.2.5 Removal Assessment.

A6.2.8 Site Reassessment

The decisions to be made from this investigation are:

- Determine whether new conditions at the site warrant further assessment under CERCLA.
- Determine whether there is a potential need for a removal action.

A6.3 Inputs into the Decision

The types of information inputs required to resolve the decision statements presented in Section A6.2 are listed below. The information is gathered from numerous sources including the site reconnaissance, interviews of site owners, operators, employees, and/or others related to the site, analytical data generated by MDNR's ESP or other laboratory, published reference books and resources, MDNR databases, U.S. Fish and Wildlife databases, internet resources, and evaluations of site conditions by MDNR geologists.

- Historical site data including: property use, surrounding land use, site operations, ownership history, regulatory history
- Previously collected environmental sampling data
- Site reconnaissance observations
- Waste sources and target receptors, which are outlined in the Conceptual Site Model
- Census Data
- Meteorological and Climatic Data
- Geologic data provided by the GSRAD geologists
- Groundwater resource and usage data
- Surface water resource and usage
- Sensitive Environments or Species data
- Physical, chemical and toxicological data on hazardous substances of concern
- Analytical results from waste and environmental media
- Background concentrations (measured or published) of hazardous substances of concern

Waste source and affected media sampling data will be compared to background concentrations, either site specific or published data. Target sampling data will be compared to screening levels from various sources to assess the potential threat to human health and the environment posed by the site. The most commonly used screening levels include the most recent revisions of EPA's Superfund Chemical Data Matrix (SCDM), EPA's Preliminary Remediation Goals (PRGs), the Missouri Water Quality Standards (WQS), EPA's Drinking Water Standards including Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs), and Missouri Risk Based Corrective Action (MRBCA) Guidance.

Where applicable, all the information cited above will be used to generate a HRS site score using the EPA QuickScore or SuperScreen Programs to determine eligibility for placement on the NPL.

A6.4 Study Boundaries

General study boundaries for site assessment investigations as outlined in the HRS are used to evaluate targets and receptors within 4 miles of the waste sources on site with regard to groundwater, air and soil exposure pathways and within 15 miles downstream with regard to the

surface water pathway. Specific spatial boundaries and time frames for source and pathway sampling are also outlined in the HRS. For example, samples documenting actual soil contamination within 2 feet of the surface and within 200 feet of a receptor (residence, school, daycare or workplace) are higher weighted pathway score than samples outside those spatial boundaries. An example of time constraints outlined by the HRS Guidance with respect to groundwater and surface water sampling is that which requires background and target samples documenting an observed release should be collected within a similar time frame (usually 2 to 3 days).

A6.5 Decision Rules

The goals of various site assessment investigations conducted under this QAPP may be slightly different. Therefore, separate decision rules for each investigation type have been developed.

A6.5.1 Pre-CERCLIS Site Screening Investigation

The following statements describe the decision rules to apply to this investigation:

- If the answers to questions 1-3 of the CERCLA release applicability questions in Section IV of the Missouri Superfund Pre-CERCLIS Site Screening Form are "yes", and the answer to question 4 is "no", then the site is eligible for entry onto CERCLIS. Otherwise, the site is not eligible for entry onto CERLCIS and the site will be recommended for no further Superfund response action. Recommendations are provided to EPA who will make the final determination on whether to enter sites into CERCLIS.

- For CERCLIS-eligible sites, if there is a willing/capable Potentially Responsible Party (PRP) response and/or the site can be referred to another program, then a recommendation for CERCLIS entry may be deferred pending successful completion of other response action. Otherwise the site will be recommended for CERCLIS entry.

- For CERCLIS-eligible sites, if evaluation of the site using the criterion in Section IV of the Missouri Superfund Pre-CERCLIS Site Screening Form indicates that a removal action is warranted, then a Superfund Removal Site Evaluation and Removal Preliminary Assessment Form will be completed and a removal action (in addition to CERCLIS entry) will be recommended for the site. Otherwise the site will not be recommended for a removal action.

A6.5.2 Preliminary Assessment

The following statements describe the decision rules to apply to this investigation:

- If the site is determined to pose a threat to human health or the environment and/or preliminary HRS site scoring indicates that the site score would be $\geq$28.5, then the site may be recommended for further assessment under CERCLA with an appropriate priority rating. Otherwise, the site recommendation will be No Further Remedial Action Planned (NFRAP) under CERCLA.

- If site conditions indicate the need for a potential removal action, then complete a Superfund Removal Site Evaluation and Removal Preliminary Assessment Form and recommend a removal action with an appropriate priority rating. Otherwise, the site will not be recommended for a removal action.

- For sites where further CERCLA assessment and/or a removal action is warranted, if there is a willing/capable PRP response, then negotiations will be initiated for cleanup under another program with state or federal oversight. Otherwise, additional CERCLA assessment and/or a removal action will be recommended.

A6.5.3 Site Inspection

The following statements describe the decision rules to apply to this investigation:

- If the site is determined to pose a threat to human health or the environment and/or the HRS site score is ≥28.5, then the site may be recommended for further assessment under CERCLA with an appropriate priority rating. Otherwise, the site will be recommended for NFRAP under CERCLA.

- If site conditions indicate the need for a potential removal action, then complete a Superfund Removal Site Evaluation and Removal Preliminary Assessment Form and recommend a removal action with an appropriate priority rating. Otherwise, the site will not be recommended for a removal action.

- For sites where further CERCLA assessment and/or a removal action is warranted, if there is a willing/capable PRP response, then negotiations will commence for cleanup under another program with state or federal oversight. Otherwise the site will be recommended for additional CERCLA assessment, the preparation of an HRS documentation record to support listing on the NPL, and/or a removal action.

A6.5.4 Expanded Site Inspection

The following statements describe the decision rules to apply to this investigation:

- If the HRS site score is ≥28.5, then an HRS documentation record may be recommended if a decision has been made to pursue proposing the site for the NPL. Otherwise, the site will be recommended for NFRAP under CERCLA.

- If site conditions indicate the need for a potential removal action, then complete a Superfund Removal Site Evaluation and Removal Preliminary Assessment Form and recommend a removal action with an appropriate priority rating. Otherwise, the site will not be recommended for a removal action.

- For sites where placement on the NPL and/or a removal action is warranted, if there is a willing/capable PRP response, then negotiations will be initiated for cleanup under another program with state or federal oversight. Otherwise, if the Governor of Missouri supports listing, preparation of an HRS documentation record and listing on the NPL and/or a removal action will be recommended.

A6.5.5 Removal Assessment

The following statement describes the decision rule to apply to this investigation:

- If evaluation of the site using the criteria in Sections III, and IV of the Superfund Removal Site Evaluation and Removal Preliminary Assessment Form indicates that site conditions warrant

a removal action, then a removal action may be recommended with an appropriate priority. Otherwise the site will not be recommended for a removal action.

- For sites where a removal action is warranted, if there is a willing/capable PRP response, then negotiations will be initiated for cleanup under another program with state or federal oversight. Otherwise, a removal action will be recommended.

A6.5.6 Combined PA/SI Assessment
The decisions to be made from this investigation are the same as those outlined under Sections A6.5.2 Preliminary Assessment and A6.2.3 Site Inspection.

A6.5.7 Integrated Assessment
The decisions to be made from this investigation are the same as those outlined under Sections A6.5.1 Pre-CERCLIS Site Screening, A6.5.2 Preliminary Assessment, A6.5.3 Site Inspection, A6.5.4 Expanded Site Inspection, and A6.5.5 Removal Assessment.

A6.5.8 Site Reassessment
The decisions to be made from this investigation are the same as those outlined under Sections A6.5.2 Preliminary Assessment, A6.5.3 Site Inspection, A6.2.4 Expanded Site Inspection, and A6.5.5 Removal Assessment.

A6.6 Limits on Decision Error
Two potential decision errors could be made based on interpreting sampling and analytical data for each site assessment project:

- Decision Error A: Concluding that a site does not pose a potential threat to human health and the environment (which would require further assessment, removal, and/or remediation under CERCLA), when the site truly does pose a threat.

- Decision Error B: Concluding that a site poses a potential threat to human health and the environment (thereby requiring further assessment/removal/remediation under CERCLA), when the site truly does not pose a threat.

The consequences of Decision Error A, mischaracterizing a site that truly poses a threat, could have immediate and future health implications. This decision could leave contamination undetected, posing increased health risk to populations on and near the site. Further, future investigations of such a site could reveal the true hazardous level of contamination, which could present legal and credibility problems for the State and EPA.

The consequences of Decision Error B, incorrectly identifying a site for further assessment/removal/remediation under CERCLA, would cause the needless expenditure of resources (e.g. funding, time, sampling crew labor, and analytical costs). As a result, the State and EPA may be less capable of adequately responding to truly pressing problems at other sites. Further, it is likely that subsequent phases of investigation under CERCLA would reveal the true benign level of contamination, and the State and EPA could be perceived as being overly cautious and wasteful.

After examining the consequences of both decision errors, Decision Error A was identified as posing more severe consequences, because it could result in threats to human health and the environment. Consequently, the baseline condition (null hypothesis) for each site assessment project is that the site to be assessed is contaminated and will require further assessment/removal/remediation under CERCLA. A false rejection decision error corresponds to Decision Error A, and a false acceptance decision error corresponds to Decision Error B.

Numerical tolerable decision error rates are not set because the judgmental sampling approach and limited sample numbers involved in most site assessment projects do not readily allow for statistical assessment of whether or not specific decision error rate limits have been attained. However, decision errors are limited in a variety of more general ways. The probability of making a false rejection decision error, thereby mischaracterizing a site that truly poses an unacceptable risk to human health and the environment, is limited by the judgmental sampling design, the conservatively-derived comparison benchmarks values chosen, and the design of the Hazard Ranking System (HRS) which is considered an environmentally conservative model. The probability of making a false acceptance rejection decision error is limited by the PRP-conservative nature of the data put into the HRS model.

A6.7 Design Optimization

For each project, the SAU Site Project Manager, in consultation with the SAU QA Project Officer and ESP FSS sampling staff, will review the DQO output from Sections A6.1 through A6.6 together with existing environmental data for the site, and develop a sample collection design based on this review. The sample collection design will specify the type, location, timing, number of analyses per sample, and, if different than specified in Section B, the sample size, field sampling or analytical methods, and QC samples. Rationale for the location of samples and types of analyses will be thoroughly developed and supported. This information will all be documented in the sampling plan prepared by ESP and approved by the SAU Site Project Manager.

A7 Special Training Requirements/Certification

In accordance with 40 CFR Part 311, which references 29 CFR 1910.120, all staff are required to successfully complete a 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) site safety course, with 8-hour annual refreshers and medical monitoring prior to conducting any field work on a site where hazardous substances are present or suspected. Sample collectors are expected to complete the EPA course number 165.9 *Sampling for Hazardous Materials* (or equivalent) as well as receive the ESP in-house training on sample handling and collection techniques in accordance with ESP SOPs prior to performing actual sampling collection or critiquing a contractor's performance. Participation in the EPA Courses: *Preliminary Assessment, Site Inspection,* and *Hazard Ranking System* is also strongly recommended for personnel collecting samples for PA/SI work. Individuals operating the Geoprobe® and the Geoprobe® MIP are expected to receive specific instruction from factory representatives or a qualified ESP operator prior to performing site work.

A8 Documentation and Records

Documentation procedures are outlined in the following MDNR SOPs: ESP-CAS-2020 "Data Review, reduction and Transfer to LIMS", ESP-CAS-2090 "Quality Control Charts", ESP-CAS-2100 "Quality Control Procedures" for the CAS and MDNR-FSS-004 "Field Documentation" for the ESP FSS.

The reports and documents generated throughout projects are listed below. An example of each type of report and document is included in Appendix 2: Example Sampling Plan and Report Outlines.

- Site Sampling Request Memo
  This memo is generated by the SAU Site Project Manager and sent to ESP FSS (with ESP CAS copied) at the beginning of the project process. More details regarding the information included in this memo are provided in Section B1.

- Site Sampling Plan
  This plan is generated by the ESP FSS and reviewed and signed by the SAU Site Project Manager before sampling occurs. The Site Sampling Plan includes a Site Health and Safety Plan as an appendix.

- Results of Sample Analyses Report
  The laboratory will report sample results on the Results of Sample Analysis sheets. The laboratory result sheets will be generated by the ESP CAS and sent to the SAU QA Project Officer within 30 days of receipt of the samples. The sheets will include the information detailed in Table 2 on the following page.

- Site Sampling Report
  This report will be generated by the ESP FSS for all site sampling events that require a sampling plan. This would include nearly all SAU investigations except for the Pre-CERCLIS Site Screening, for which an abbreviated version of the Site Sampling Report is required (see next report description). The Site Sampling report will be submitted to the SAU Site Project Manager as soon as possible after all analytical data has been reported.

- Pre-CERCLIS Site Screening Sampling Report
  This report is an abbreviated version of the Site Sampling Report since no formal sampling plan is required for a Pre-CERCLIS Site Screening sampling event.

- QA Audit Report
  The QA Audit Report for the ESP FSS will be generated by the ESP QA Field Auditor and submitted to the subject of the audit, his/her supervisor, and the ALPD QA Manager

Table 2. Data To Be Included in Laboratory Results of Sample Analysis Sheets

Report Sheet Element	Comment
Title	e.g. "Results of Sample Analysis"
Site name	From the COC form "Site/Study Name:" field
County	From the COC form "County" field
Program Contact	
LDPR and Job Code	
Sample number	From the COC form "Sample Number" field
Sampling location	Latitude and longitude
Sample description	From the COC form "Description (permit/station number, sample type, etc.):" field.
Date and time of sample collection	From the COC form "sample Collected" field
Sample collector & affiliation	From the COC form "Collector's Name" and "Affiliation" fields
Date sample received	
Report Date	
Analytical method used	
QC Batch ID	
Sample Matrix	From the COC form "Matrix" field
Practical Quantitation Limit (PQL)	Included in the "Result" column when qualifier "ND" is used.
Units (e.g. ug/l, mg/kg, etc.)	
Qualifier	From the list in Appendix 8.

A Laboratory Information Management System (LIMS) at the ESP maintains all information and data on all environmental samples received. The system is utilized to log in samples collected, record results of analyses, and generate sample analyses and management reports. The LIMS is backed up daily, weekly, and monthly. The monthly backups are sent offsite for long-term storage. All other backup tapes are stored in a data quality fireproof safe. System maintenance is performed weekly. This includes checking for operating system errors, LIMS system errors, and database integrity.

All original copies of site-specific reports and documents will be stored in site specific files in the HWP Records Center. All non-site specific quality management reports and documents relating to this QAPP will be stored in the QA/QC Superfund SAU File in the HWP Records Center. The QA Manager for the department identifies all QA and QC documents listed in the ALPD Agency

Records Disposition Schedule. The SAU and ESP will follow the current Agency Records Disposition Schedule approved by the Secretary of State's Office for all QA and QC documents and records of environmental data.

B. MEASUREMENTS/DATA ACQUISITION

B1 Sampling Process Design

Sampling conducted during site assessment projects will be designed to meet the general DQOs developed for the specific project type as discussed in Section A6. Additional site-specific DQOs may be developed for individual projects, and these will be specified in the sampling request memo prepared by the SAU Site Project Manager. Site assessment projects are primarily limited screening investigations, the results of which will be used to determine the appropriate next course of action (e.g. further CERCLA site assessment, removal action, remedial investigation, or response by other non-CERCLA authorities). The projects usually involve small numbers of samples (fewer than 20), and budget limitations both of which preclude implementing a statistical sampling design. Based on these factors, the sampling designs for site assessment projects will primarily use the judgmental sampling technique. Limited composite sampling will be used as appropriate on a project-specific basis. The specific sampling design for each project will be described in a sampling request memo prepared by the SAU, and fully documented in the final sampling plan prepared by ESP.

Based on available site information, and data gathered during the site reconnaissance, the SAU Site Project Manager will prepare a sampling request memo. The memo will provide general site background information, describe the number, type, and location of samples to be collected, along with analytical parameters requested for each sample. The SAU Site Project Manager will use the DQO process described in Section A6 to develop the sampling request memo. The memo will be reviewed by the SAU QA Project Officer prior to submission to ESP. Approval will be documented by initialization of the memo. Because the SAU QA Project Officer is independent of those responsible for generating the data, (i.e. ESP), their approval of the sampling request memo in terms of QA requirements is sufficient to ensure the project sampling design is adequate to meet the DQOs of the QAPP and will be of usable quality. The SAU Site Project Manager will also notify the CAS by e-mail in advance of sampling to indicate the anticipated number and type of samples to be collected, the date(s) of sampling, and the analyses required.

Based on the sampling request memo, ESP will prepare a draft sampling plan in accordance with "Guidance for Performing Site Inspections Under CERCLA" (September 1992). An example sampling plan outline is provided as Appendix 4. The draft sampling plan will be sent to the SAU Site Project Manager for approval. Sampling plan approval will be documented on the signature page, which will include the signature of the ESP personnel who prepared the report and the approval signature of the SAU Site Project Manager. Sample collection is typically conducted by ESP personnel, with on-site oversight by the SAU Site Project Manager. However, for some projects with limited sampling needs, the SAU Site Project Manager will conduct the sampling.

The sampling plan will provide a best estimate of the number and types of samples to be collected,

but site conditions at the time of sampling will determine the actual number and type of samples collected. Decisions on deviations from the sampling plan in terms of sampling points and parameters will be made and approved by the SAU QA Project Officer or SAU Site Project Manager who approved the sampling plan. The deviations or changes will be documented in a field notebook, and in the final sampling report prepared by the ESP and submitted to the SAU.

A background sample will be collected for each type of environmental media sampled (e.g. soil, sediment, groundwater, surface water, air) for each project in accordance with the guidance provided in MDNR-FSS-210 "Quality Assurance/Quality Control for Environmental Data Collection".

Most Pre-CERCLIS SS projects that require sampling are more limited in scope than the other project types covered by this QAPP. When SAU personnel request assistance from ESP for a SS project, pre-sampling site reconnaissance and the preparation of a formal sampling plan may be performed, but are not always necessary. The SAU Site Project Manager will submit a sampling request memo to ESP as described above. For most SS projects, the sample request memo will also serve as the sampling plan. Sample collection is typically conducted by ESP personnel, with on-site oversight by the SAU Site Project Manager. For some SS projects with limited sampling needs, SAU will conduct the sampling independently. The sampling event will be documented either in a Pre-CERCLIS sampling report prepared by ESP, or when SAU personnel conduct the sampling, in a sample event memo prepared by the SAU Site Project Manager.

B2 Sampling Methods and Procedures

The field investigations and sample collection activities for all projects will adhere to the methods described in the following department SOPs: MDNR-FSS-005 "General Sampling Considerations Including the Collection of Grab, Composite, and Modified Composite Samples from Streams and Wastewater Flows," MDNR-FSS-007 "Collection of Samples from Wells," MDNR-FSS-010 "Collection of Soil Samples," MDNR-FSS-011 "General Sampling Considerations for Sediments," MDNR-FSS-008 "Collection of Samples from Drums," MDNR-FSS-006A "Sampling Water and Other Liquids for Volatile Organic Analysis (VOA)", and MDNR-FSS-006B "Sampling of Soil and Other Solid Media for Volatile Organic Analysis (VOA)." Sampling equipment that will require field decontamination will be handled in accordance with methods outlined in MDNR-FSS-206 "Decontamination Procedures for Sampling Equipment." Minimum sample volumes, preservation, and holding times are specified in Appendix 5.

Additional sample volume will be collected from one background sampling location of each matrix sampled for each project. The additional volume will provide enough sample for the laboratory to conduct matrix spike and matrix spike duplicate analyses on the background sample. Collection of twice the optimum volume specified in Appendix 5 will provide sufficient sample volume.

The SAU Site Project Manager, in consultation with the ESP sampling staff will be responsible for corrective action regarding any failures in sampling encountered in the field. Unanticipated needs to deviate significantly from these sampling methods and procedures in the field will be approved by the SAU Site Project Manager in consultation with ESP sampling staff.

B3 Sample Handling and Custody Requirements

Chain-of-custody and field documentation of samples collected for this project will be in accordance with MDNR-FSS-002 "Field Sheet and Chain-of-Custody Record" and MDNR-FSS-004. The handling of samples collected for this project in the field and upon return to the laboratory will be in accordance with MDNR-FSS-018 "Sample Handling: Field Handling, Transportation and Delivery to the ESP Lab". The containers, preservation, and holding times for samples collected for this project will be in accordance the tables in Appendix 5.

B4 Analytical Method Requirements

ESP will use analytical methods capable of achieving the Practical Quantitation Limits (PQLs) specified in Appendix 6. The majority of samples collected for this project will be analyzed utilizing EPA SW-846 Methods or EPA Methods for Chemical Analysis of Water and Wastes. All analyses will be conducted in accordance with applicable ESP CAS SOPs. Analytical methods for each parameter are listed in the tables of Appendix 6. Some analytes may be analyzed by more than one method.

Some parameters in drinking water samples may need higher sensitivity than typically obtained using SW-846 methods, requiring the use of drinking water methods. These include pentachlorophenol, and the Polynuclear Aromatic Hydrocarbons (PAHs). The SAU Site Project Manager will be responsible for indicating in the sampling request memo which sensitivity level will be required when applicable. Where a method other than SW-846 is to be used, it will be indicated on the Chain of Custody form completed by the sample collector.

Any analytical work not performed by the ESP will be conducted at a laboratory under contract with the ESP. The contract will specify that EPA SW-846 methods or other methods as specified will be utilized and that the QC procedures specified in these methods be followed. The contract will require that all QC documentation be provided with each analytical deliverable package. The ESP will be responsible for ensuring all analytical data provided under contract for the project meets the contract requirements and the requirements of this QAPP.

B4.1 List of Target Analytes

The analytes most commonly requested for projects under this QAPP are included in the tables of Appendix 6. The specific analytes required will vary on a project-specific basis, and will be specified in the sample request memo, in the formal sampling plan, and in the chain of custody submitted to the CAS with the samples. Some analyses are requested by referencing commonly grouped analytes such as Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs), pesticides and herbicides, and RCRA Metals. The specific analytes to be included in these groups when requested are listed in the tables of Appendix 6. For some projects analytes other than those listed in Appendix 6 will be required. The SAU Site Project Manager will consult with the CAS on special analytical needs for these projects well in advance of sampling.

B4.2 Sensitivity Requirements

Method Detection Limits (MDLs) for each analytical parameter will be established by the CAS as specified in 40 CFR 136 Appendix B and Section 5, Chapter 1, Quality Control, of SW-846. PQLs as defined in 40 CFR Part 300 Appendix A, Section 1.1 will be developed by the CAS. The CAS will use the PQL as reporting limits for all analyses conducted under this QAPP.

Analytical results obtained for projects conducted under this QAPP will be compared to various screening benchmarks, the most common of which include EPA's SCDM, EPA's PRGs, the Missouri Water Quality Standards, and MRBCA Guidance. Ideally, the laboratory reporting limits would be at or below each benchmark value in each environmental media.

However, these screening benchmarks are primarily health-based values, and do not take into account analytical feasibility. Even using the best available measurement technology, laboratory-reporting limits will exceed benchmarks for some analytes in some environmental media. In consultation with CAS, tables of PQLs that are analytically achievable and sufficient to meet the sensitivity requirements for most projects have been developed and are included as Appendix 6. It is important to note that interferences caused by difficult sample matrices and highly contaminated samples may cause PQLs to be elevated above those listed in Appendix 6.

The tables in Appendix 6 provide a list of laboratory reporting limits that, if met, will be sufficient to meet the sensitivity DQO for most projects. However, there may be special circumstances where a higher level of sensitivity for some analytes will be required. Similarly, there may be projects where analyte(s) not included in Appendix 6 will be of interest. And for some projects, alternative benchmarks or other health-based screening levels not cited above may be used. In all of these instances, the SAU Site Project Manager will consult with ESP CAS well in advance of sampling regarding the appropriate analytical method, to verify that the laboratory PQL will meet the project DQOs, and to determine the appropriate course of action where applicable (e.g. the use of an alternative analytical method or subcontracting to another laboratory).

Due to the common use of methylene chloride as a sample extraction solvent, ambient background levels of this compound are typically present in the CAS laboratory facilities, resulting in an elevated PQL for this compound. The most commonly used benchmark for water (the MCL) is below the Appendix 6 PQL for methylene chloride. However, where necessary, the CAS can take special analytical measures to achieve an PQL at or below the MCL. For projects involving sites where methylene chloride is a known or suspected contaminant in water, and the achievement of an PQL at or below the MCL is needed, the SAU Site Project Manager will notify the CAS in advance of sampling to request that special analytical precautions be taken.

Data that do not meet the laboratory reporting limits in Appendix 6 will be qualified by the ESP CAS as described in the applicable verification/validation procedure (Section D), and documented in the project report.

B4.3 Laboratory Turnaround Time Requirements

All analyses will be conducted within the EPA-specified maximum sample holding time limits specified in the tables of Appendix 5. ESP will provide the analytical data report sheets to the SAU QA Project Officer within 30 calendar days of the delivery of samples to the ESP laboratory for analysis. In the event that the 30-day turn around time cannot be met, the ESP will notify the SAU QA Project Officer. The SAU authorizes the ESP to contract out analysis for those samples that will not meet the 30-day turnaround time due to workload at the ESP. The SAU may request expedited turnaround time (10 days) for laboratory analysis of samples at certain sites, such as those being assessed for time-critical removal action. It is estimated that the SAU will request expedited turnaround time for ten sites in any given fiscal year. In these cases, the SAU Site Project Manager will notify the CAS by e-mail well in advance of sampling to specify the analytes number of samples, and date by which results are needed.

Any data obtained from analyses conducted on samples after the holding time limits specified in Appendix 5 will be qualified by the CAS as described in the applicable validation procedure (Section D) and discussed in the project report.

B5 Field and Laboratory Quality Control Elements

A number of field and laboratory QC checks will be required to ensure data meet the project DQOs. The principal quality attributes important to site evaluation projects are precision, accuracy, comparability, representativeness, and completeness. Criteria for these attributes are discussed below. All QC samples, including field blanks, trip blanks, equipment rinsate blanks, replicate splits and duplicate samples will be collected in accordance with MDNR-FSS-210 "Quality Assurance/Quality Control for Environmental Data Collection."

B5.1 Precision

Precision is a measure of mutual agreement among individual measurements of the same property, under prescribed similar conditions. It is typically expressed in terms of the standard deviation among a set of data or as the relative percent difference between two measurements. For the purposes of this QAPP the components of precision have been grouped into those associated only with the laboratory analysis, and those associated with the overall sampling and analysis process.

B5.1.1 Laboratory Precision

Precision of laboratory analyses is assessed by the analysis of Matrix Spike/Spike Duplicates (MS/MSD), laboratory duplicate samples, and blind performance evaluation samples. The frequency with which laboratory precision is assessed, and the performance criteria vary by analyte, analytical method, and environmental media. The criteria and methods for assessment of laboratory precision are specified in the analytical methods and are developed in accordance with MDNR-CAS-2090, MDNR-CAS-2100, MDNR-CAS-2070, and CAS SOPs for the various analyses. Data that do not meet the laboratory precision criteria 3 will be qualified by the CAS as described in the applicable validation procedure (Section D), and discussed in the project report.

B5.1.2 Overall Sampling and Analysis Precision

Total precision of the entire sampling and analytical process will be assessed using analyses of blind field duplicate and replicate split samples. Aqueous and air precision QC samples will be collected

as duplicates, while non-aqueous precision QC samples will be sampled as replicate splits. Definitions of the terms "duplicate" and "replicate split" are provided in MDNR-FSS-210. Non-aqueous samples to be analyzed for VOCs cannot be homogenized prior to collection due to the potential for loss of VOCs. Therefore, in place of replicate split samples, for projects involving the collection of non-aqueous samples for VOC analysis, duplicate non-aqueous samples will be collected. Duplicate air samples collected in accordance with EPA Method TO-15 will consist of two samples analyzed from the same Summa canister, while replicate split samples will be samples analyzed from two separate canisters collected from the same air mass.

Due to differences in DQOs, the frequency of precision QC sampling will be slightly different for site screening investigations compared to the other projects covered by the QAPP. For site screenings, one set of precision QC samples will be collected per site. The SAU Site Project Manager, together with the ESP FSS personnel will select the media to be sampled in duplicate/replicate. Typically whichever media is sampled most for a given SS project will be chosen for duplicate/replicate sampling, however, there may be exceptions made on a project specific basis.

For all other projects, duplicate and/or replicate split samples will be collected at a rate of 10% of the total number of samples collected per media (groundwater, surface water, soil/sediment, air) or at least one per media per sampling event. Where both soil and sediment are sampled, the SAU Site Project Manager, together with ESP FSS personnel will typically collect the replicate split of whichever media is sampled most at a given project. Should a project require 10 or more soil and/or sediment samples, separate replicate splits will be collected of each non-aqueous media. Figure 2 on the following page provides several example sampling scenarios with associated precision QC sampling to illustrate these differences.

Table 3: Example Sampling Scenarios and Associated Precision QC Samples*

Project A (Pre-CERCLIS Site Screening)

Samples Collected/Analyses Requested	Precision QC Samples
4 Soil/VOCs, SVOCs, metals	1 Soil replicate split/SVOCs, metals
2 Sediment/VOCs,SVOCs	1 Soil duplicate for VOCs
2 Groundwater/VOCs	

Project B (Pre-CERCLIS Site Screening)

Samples Collected/Analyses Requested	Precision QC Samples
2 Soil/VOCs, SVOCs	1 Surface water duplicate/VOCs, metals
2 Sediment/metals	
2 Groundwater/VOCs	
4 Surface Water/VOCs, metals	

Project C (PA/SI)

Samples Collected/Analyses Requested	Precision QC Samples
6 Soil/VOCs, SVOC	1 Soil replicate split/ SVOCs
2 Sediment/VOCs, SVOC	1 Soil duplicate/VOCs
3 Groundwater/VOCs	1 Groundwater duplicate/VOCs
6 Surface water/VOCs, SVOC	1 Surface water duplicate/VOCs, SVOCs

Project D (ESI)

Samples Collected/Analyses Requested	Precision QC Samples
11 Soil/metals, VOCs	2 Soil replicate splits/metals
3 Sediment/metals, SVOCs	2 Soil duplicates/VOCs
20 Groundwater/VOCs	1 Sediment replicate split/metals, SVOCs
9 Surface water/metals, VOCs	2 Groundwater duplicates/VOCs
	1 Surface water duplicate/metals, VOCs

Project E (ESI)

Samples Collected/Analyses Requested	Precision QC Samples
11 Soil/metals	2 Soil replicate splits/metals
11 Sediment/metals, SVOCs	2 Sediment duplicates/metals, SVOCs
21 Groundwater/VOCs	3 Groundwater duplicates/VOCs
2 Surface water/metals, VOCs	1 Surface water duplicate/metals, VOCs

*These examples are intended as an aid in interpreting the precision QC sampling frequencies described in this section. They are not to be used as a general template or directly applied to any specific site.

For some projects, the physical properties of site soils will not lend themselves to effective homogenization. The inability to adequately mix some highly plastic clayey and silty clay soils may preclude collection of replicate split samples for some projects. The SAU Site Project Manager together with the ESP FSS personnel will use professional judgement in the field to determine when to forego the collection of non-aqueous replicate splits. For a limited number of projects a higher frequency of precision QC samples will be requested. In these cases, the SAU Site Project Manager will specify the QC sample requirements in the sample request memo to ESP.

Overall precision will be measured using the Relative Percent Difference (RPD) between duplicate or replicate split samples. The RPD will be calculated by the SAU Site Project Manager as:

$$RPD = 100\left[\frac{x_1 - x_2}{\bar{x}}\right]$$

The criterion for RPD between primary and duplicate aqueous samples for each contaminant measured above the laboratory reporting level is ≤ 30%. The criterion for RPD between primary and replicate split non-aqueous samples and for duplicate non-aqueous VOC samples will be ≤ 50%. The criterion for RPD between primary and duplicate air samples will be 25%. If data fall within these limits, then the overall precision of the sampling and analytical process is adequate to meet the project DQOs. Data that do not meet these precision criteria will be qualified as described in the applicable validation procedure (Section D), and discussed in the project report.

Because this QAPP is generic, covering many different projects and project types, these precision criteria will be applied to a large number of analytes in various complex sample matrices. It is not likely that the precision limits for the overall sampling and analytical process will be met for every contaminant in every sample for every project. This is especially true for projects involving the sampling of non-aqueous matrices. When released to the environment, many contaminants distribute themselves extremely unevenly in soils; even on the small scale at which sampling occurs. This problem is further confounded by the heterogeneous nature of the dense clayey and silty clay soils found in many areas of the state. The need to collect duplicate non-aqueous samples for VOC analysis exacerbates the problem further still, since the primary and duplicate samples may not be homogenized prior to analysis. Great care will be taken when interpreting overall sampling and analysis precision data for non-aqueous duplicate and replicate split samples. The SAU QA Project Officer and Site Project Manager, in consultation with appropriate ESP personnel, will evaluate all qualified data on a project-specific basis, and determine how/whether to use the data.

B5.1.3 Accuracy

The accuracy of laboratory analyses will be assessed by analysis of preparation/method blanks, laboratory control samples, surrogates, internal standards, matrix spikes, and blind performance samples. The frequency with which laboratory accuracy is assessed, and the performance criteria vary by analyte, analytical method, and environmental media. Criteria for laboratory accuracy are specified in the analytical methods and will be developed and maintained in accordance with the following CAS SOPs: MDNR-CAS-2090, MDNR-CAS-2100.

Field accuracy will be assessed through the analysis of trip blanks, field blanks, and field equipment rinse blanks. For all projects involving the collection of aqueous samples, a trip blank will be included at a frequency of one per separate sampling event (mobilization) per sample cooler. If aqueous samples are collected from multiple projects during the same mobilization for the same analytical parameters, a single trip blank per cooler may be used to assess accuracy for all of the projects. A field blank may be requested by the SAU Site Project Manager for some projects where the potential for contamination of samples by atmospheric pollutants is suspected. An equipment rinsate blank will be collected for projects where the sampling equipment is decontaminated in the field for reuse. The equipment rinseate blank will be collected at a frequency of one per separate sampling event (mobilization) for each different combination of sampling equipment, decontamination method, and analytical parameter.

Contaminants should not be detected above the laboratory reporting level in trip blanks, field blanks, and equipment rinse blanks. Any data that do not meet these accuracy criteria will be qualified as described in the applicable validation procedure (Section D). The SAU QA Project Officer and Site Project Manager in consultation with appropriate ESP personnel will evaluate all qualified data on a project-specific basis, and determine how/whether to use the data.

B5.1.4 Data Comparability

Comparability is an expression of the confidence with which one data set can be compared to another. The objective of comparability for this QAPP is to ensure that sampling data developed during the project investigation may be readily compared to each other and to the appropriate screening benchmarks. All data will be reported as ^{o} Celsius (flash point) pH units, μg/l or mg/l for

water, liquids or Toxicity Characteristic Leachate Procedure (TCLP), µg/kg or mg/kg for soil, sediment or other solids, and $\mu g/m^3$ for air. Comparability is further addressed by using appropriate field and laboratory methods that are consistent with current standards of practice as approved by EPA.

B5.1.5 Data Representativeness

Data representativeness addresses both the degree to which measurements "truly" reflect the actual value within the identified sampling unit (within-sampling-unit representativeness), and the degree to which sampling units selected for sampling reflect the overall population of interest (between-sampling-unit representativeness).

Most projects will employ the use of a judgmental sampling design. The use of judgmental sampling limits inferences that can be drawn between sampling units and extrapolation from those units to the overall population is subject to unknown selection bias. This is true because these inferences are based on the logic flow inherit in the conceptual site model upon which the sampling units and sample locations were based. Between-sampling-unit representativeness will be ensured with the use of good professional judgement by the SAU Site Project Manager in constructing the conceptual site model and preparing the sampling design.

Within-sampling-unit representativeness is ensured for projects under this QAPP in several specific ways that are further discussed in other sections of this QAPP:

- Use of correct sampling procedures and equipment (Section B2)
- Adherence to QA and QC requirements for ensuring sample integrity (Section B5)
- Collection of an adequate amount of sampled material (Section B2 and Appendix 5)
- Selection and implementation of appropriate analytical measurement method, including sample preparation (Section B4 and Appendix 6).

B5.1.6 Data Completeness

Completeness is expressed as a percentage of the amount of valid data obtained compared to the amount that was planned. One hundred percent of data completeness is desired for the collection of field samples for all project investigations. If less than 100 percent is received, the QA Project

Officer will decide if the valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions is sufficient to meet the project DQOs. If not, additional sampling will be required.

B6 Instrument/Equipment Maintenance and Calibration Requirements

Field analytical instruments used during this project will be maintained and calibrated according to instructions provided by the instrument manufacturer, and applicable field analytical methods.
All major laboratory instruments used for quantitative sample analysis in the CAS are covered by service/maintenance contracts with the instruments' vendors. In addition to the detailed maintenance

procedures performed as part of these contracts, the analytical staff of the laboratory perform the routine daily maintenance and calibration procedures which are necessary to ensure that the analytical data produced is of definable quality and meets the DQOs of the projects. Maintenance and calibration procedures are conducted in accordance with manufacture's instrument manuals, MDNR-CAS-2040, and other CAS SOPs for specific instruments/analyses. A full list of applicable CAS SOPs is included as Appendix 7.

B7 Inspection/Acceptance Requirements for Supplies and Consumables

These requirements are specified in MDNR-CAS-2140 "Supplies Procurement, Inspection and Acceptance."

B8 Non-direct Measurements

Several types of data and information will be obtained from non-measurement sources for use in projects conducted under this QAPP. The primary types of non-measurement data are listed in Section A6.3. These data will be used with the directly measured data collected during each project to evaluate potential uncontrolled hazardous substance sites as described in Section A3. Non-direct measurement data must meet the documentation and referencing provisions of the EPA Guidance Document, *Regional Quality Control Guidance for NPL Candidate Sites*, (U.S. EPA, 1991b). All non-direct measurement data will be reviewed and approved for use in the project report by the EPA Site Assessment Manager responsible for overseeing projects conducted under this QAPP.

B9 Data Management

Data management will be in accordance with the following SOPs: MDNR-CAS-2000 , MDNR-CAS-2020, MDNR-CAS-2090, MDNR-CAS-2100, and MDNR-CAS-2130.

Documentation will be in accordance with MDNR-FSS-004, and will include the sampling reports, copy of the chain-of-custody, and field QA controls with the analytical results. Data reduction will occur in accordance with MDNR analytical SOPs for each parameter. If difficulties are encountered during sample collection or sample analyses, a brief description of the problem will be provided in the sampling report prepared by ESP. The laboratory qualifiers listed in Appendix 8 will be used where applicable on the results of analysis report sheets provided by the CAS. Data reporting will be in accordance with MDNR-CAS-2020.

Adequate precautions will be taken during the reduction, manipulation, and storage of data in order to prevent the introduction of errors or the loss or misinterpretation of data. The LIMS maintains all information and data on all environmental samples received. The system is utilized to log in samples collected, record results of analyses, and generate sample analyses and management reports. The LIMS is backed up daily, weekly, and monthly. The monthly backups are sent offsite for long-term storage. All other backup tapes are stored in a data quality fire proof safe. System maintenance is performed weekly. This includes checking for operating system errors, LIMS system errors, and database integrity.

The current Agency Records Disposition Schedule approved by the Secretary of State's Office for all QA and QC documents and records of environmental data will be followed.

C. ASSESSMENT/OVERSIGHT

C1 Assessment and Response Action

This section describes the internal and external checks necessary to ensure that all elements of the QAPP are correctly implemented as prescribed, that the quality of the data generated by implementation of the QAPP is adequate, and that any necessary corrective actions are implemented in a timely manner.

C1.1 Laboratory Performance Assessment

The CAS participates in semi-annual round robin audit studies that are purchased from a National Institute of Standards and Technology (NIST) approved provider. These studies provide all of the EPA and the NELAC requirements for laboratory QA programs. Data resulting from the participation in this program are reviewed by the ALPD QA Manager and any problems are addressed.

EPA, Region VII conducts periodic Laboratory On-Site Evaluations to assess the laboratory procedures in order to maintain certification under the requirements of the Safe Drinking Water Act and for other state operated, federally-funded programs.

C1.2 Field Performance Assessment

The auditor in charge of ESP field QA will conduct audits of field activities according to MDNR-FSS-211 "Quality Assurance Field Auditing Procedures." The process of choosing when field audits are conducted is not based on a particular project or site-sampling event, but rather is based on assuring that each ESP staff member involved in sample collection is audited at least once per year. The time of year, and thus the particular site-sampling event field personnel are working on, is randomly chosen. A minimum of two audits will be conducted each year under this QAPP.

For this project, the ESP field QA auditor is authorized to issue a stop work order upon finding a significant condition that would adversely affect the quality and usability of the data. The ESP field QA auditor will have the responsibility for initiating and implementing response actions associated with findings identified during the field audit. The procedures require that the field personnel properly address any response actions needed.

C1.3 Overall Project Performance Assessment

Overall performance auditing of projects conducted under this QAPP will be undertaken annually by the EPA Site Assessment Manager. These audits will evaluate the effectiveness of the projects in attaining the stated DQOs, documentation practices, and the overall quality of project reports.

EPA Region VII conducts periodic evaluations of the state's environmental programs. These evaluations normally include some type of review of the program's quality management system, and may include examination of ALPD QAPPs.

C1.4 Data Validation

All field and laboratory data will be subject to validation by review for accuracy, precision, completeness, representativeness and comparability. The acceptance criteria for measurement data are discussed in Section B5. Data validation procedures are presented in Section D2.

C2 Reports to Management

Field performance assessment audits will be documented by the ESP field QA auditor in a written report that shall be kept on file at the ESP. Copies of the written report shall be provided to the subject of the audit, his/her supervisor, and the ALPD QA Manager upon request.

Results from the laboratory's semi-annual participation in the round robin audit studies, and from EPA Region VII's periodic On-Site Laboratory Evaluations will be kept on file at ESP. Copies of these results will be provided to the HWP QA Coordinator.

Findings from the EPA Site Assessment Manager annual overall project evaluation are documented in a letter to the HWP QA coordinator, who facilitates the implementations of any recommendations and/or corrective actions needed.

Comments and recommendations from the EPA Region VII periodic evaluations of state environmental programs are provided to the ALPD QA manager and used by ALPD management and staff to take any corrective actions which may be needed.

D. DATA VALIDATION AND USABILITY

D1 Data Verification, Validation, and Data Quality Assessment

This section describes the process for documenting the degree to which the collected data meet the project objectives, individually and collectively, and to estimate the effect of any deviations on the ability to use the data for addressing the decision rules described in Section A6.5.

D1.1 Sampling Design

The ESP FSS personnel responsible for the project will verify that the sampling plan conforms with the number, type, location, and requested lab analyses specified in the sampling plan memo prepared by the SAU Site Project Manager. During preparation of the sampling report, ESP FSS personnel will verify that the actual number, type, location, and requested lab analyses collected conform with that specified in the sampling plan. Any deviations noted during sampling design verification will be documented by the ESP FSS personnel in the sampling report. Validation of the sampling design

will be conducted by the SAU Site Project Manager during review of the sampling report, and by the SAU QA Project Officer during review of the project report.

D1.2 Sample Collection and Handling Procedures

The ESP FSS personnel responsible for the project and the ESP Director will provide verification and validation that the field portions of all sample collection and handling procedures used conform with those specified in Sections B2, B3, and Appendix 5 of this QAPP. The CAS supervisor will provide verification and validation that the laboratory portions of all sample handling procedures used conform with those specified in Section B3 and Appendix 5 of this QAPP. The data will be further validated by the SAU Site Project Manager during review of the sampling report, and by the SAU QA Project Officer during review of the project report.

D1.3 Analytical Procedures

The CAS supervisor will provide verification and validation of each sample to ensure that the procedures used to generate the data were implemented as specified in Section B4 of the QAPP. Any deviations will be documented in the sampling report. The data will be further validated by the SAU Site Project Manager during review of the sampling report, and by the SAU QA Project Officer during review of the project report.

D1.4 Quality Control

The ESP FSS personnel responsible for the project will provide verification and validation that the data generated conform with the field QC elements in Section B5 of this QAPP. The CAS supervisor will provide verification and validation that the data generated conform with the laboratory QC elements of Section B5. Any QC deviations noted during verification and validation will be documented in the sampling report. The QC data will be further validated by the SAU Site Project Manager during review of the sampling report, and by the SAU QA Project Officer during review of the project report.

D1.5 Calibration

The CAS supervisor will provide verification and validation that the data generated conform with the instrument/equipment maintenance and calibration requirements in Section B6 of this QAPP. Any deviations noted during verification and validation will be documented in the sampling report.

D2 Validation and Verification Methods

Data validation methods are described in the analytical CAS SOPs for specific analyses and in MDNR-CAS-2020, MDNR-CAS-2070, MDNR-CAS-2090, MDNR-CAS-2100, MDNR-CAS-2130, MDNR-FSS-002, MDNR-FSS-003, MDNR-FSS-004, MDNR-FSS-018, MDNR-FSS-210, and MDNR-FSS-211.

Results of data verification and validation performed by ESP will be documented in the sampling report provided to the SAU for each project. Validation activities conducted by the SAU will be documented in the project report.

D3 Reconciliation with User Requirements (Data Quality Assessment)

Results of each project will be reconciled with data user requirements using the Data Quality Assessment (DQA) process described in *Guidance for Data Quality Assessment*, EPA QA/G-9, July 2000. The DQA guidance was developed primarily for projects whose DQOs are amenable to evaluation by statistical analyses. The limited number of samples collected for most site assessment projects, and the nature of the DQOs developed for this QAPP are not readily evaluated by statistical analyses.

At the completion of the project, the SAU Site Project Manager, together with the SAU QA Project Officer will review the sampling design, and data collection and analysis documentation to evaluate their consistency with the project DQOs specified in the QAPP and sampling plan. If it is determined that the DQOs are not met, the SAU Site Project Manager, together with the SAU QA Project Officer and HWP QA Coordinator, will identify the appropriate corrective measures necessary, and ensure they are implemented. These measures will most commonly include laboratory re-analysis, re-sampling, and/or the collection of additional samples.

The EPA Site Assessment Manager, as the data user, will make the final determination on whether the quality of the validated data supports the decisions/recommendations made in the project report.

E. REFERENCES

Missouri Department of Natural Resources, 1999, Locational Data Method Accuracy Description. Air and Land Protection Division. Version 6.1.1.

U.S. EPA, 1991a, Guidance for Performing Preliminary Assessments under CERCLA. Office of Emergency and Remedial Response, Washington, DC. EPA/540/G-91/013.

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U.S. EPA, 1992a, Guidance for Performing Site Inspections under CERCLA – Interim Final. Office of Emergency and Remedial Response, Washington, DC. EPA/540/R-92/021, Publication PB92-963375.

U.S. EPA, 1992b, Hazard Ranking System Guidance Manual. Office of Solid Waste and Emergency Response, Washington, DC. EPA/540/R-92/026, Publication 9345.1-07.

U.S. EPA, 1993, Integrating Removal and Remedial Site Assessment Investigations, Office of Solid Waste and Emergency Response. EPA/540/F-93/038, Directive 9345.1-16FS.

U.S. EPA, 1998, EPA Guidance for Quality Assurance Project Plans, EPA/QA/G-5. Office of Research and Development, Washington, DC. EPA/600/R-98/018.

U.S. EPA, 1999a, Improving Site Assessment: Combining PA/SI Assessments. Office of Solid Waste and Emergency Response, Washington, DC. EPA/540/F-98/038, OSWER 9375.2-10FS.

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U.S. EPA, 2000a, Data Quality Objectives Process for Hazardous Waste Site Investigations, EPA QA/G-4HW, Office of Environmental Information, Washington, DC. EPA/600/R-00/007.

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U.S. EPA, 2000c, Guidance for the Data Quality Objectives Process, EPA QA/G-4. Office of Environmental Information, Washington, DC. EPA/600/R-96/055.

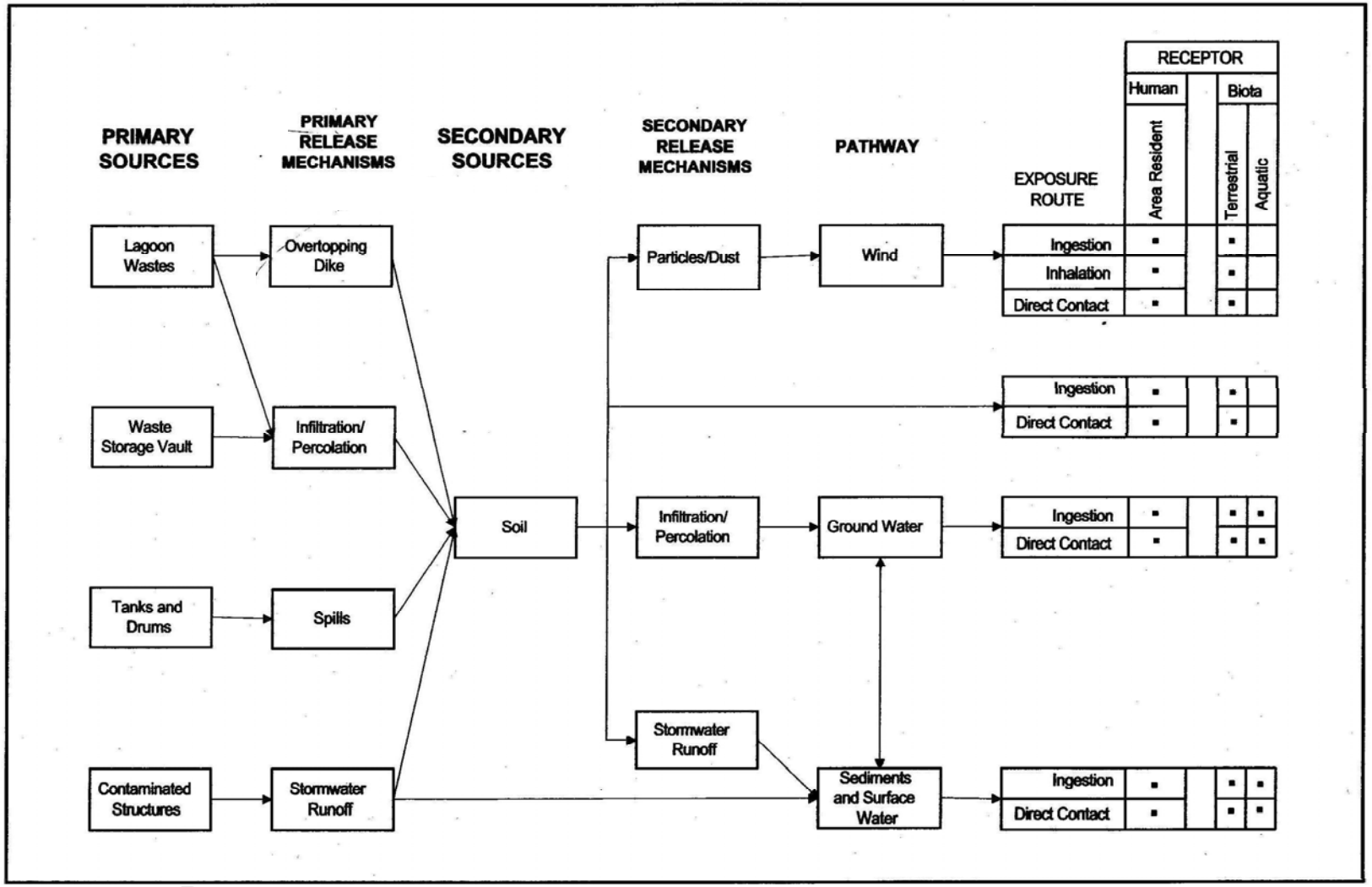
U.S. EPA, June 2001, Guidance on Environmental Data Verification and Data Validation – Peer Review Draft, EPA QA/G-8. Office of Environmental Information, Washington, DC.

U.S. EPA, September 2001, Guidance on Data Quality Indicators – Peer Review Draft, EPA QA/G-5I. Office of Environmental Information, Washington, DC.

U.S. EPA, 2001, EPA Requirements for Quality Assurance Project Plans, EPA/QA/R-5. Office of Environmental Information, Washington, DC. EPA/240/B-01/003.

U.S. EPA, July 2002, Guidance for Quality Assurance Project Plans - Peer Review Draft, EPA/QA/G-5. Office of Environmental Information, Washington DC.

APPENDIX 1: EXAMPLE CONCEPTUAL SITE MODEL (CSM) DIAGRAM



APPENDIX 2: EXAMPLE SAMPLING PLAN AND REPORT OUTLINES

OUTLINE FOR SAMPLING PLAN

1.0 INTRODUCTION

2.0 SITE INFORMATION

- 2.1 LOCATION
- 2.2 DESCRIPTION
- 2.3 HISTORY/CONTAMINANTS OF CONCERN

3.0 SITE RECONNAISSANCE

4.0 FIELD ACTIVITIES

- 4.1 SAMPLING METHODS
  - *4.1.1 Soil sampling*
    - 4.1.1.1 Surface soil sampling
    - 4.1.1.2 Depth-discrete soil sampling
  - *4.1.2 Water sampling*
    - 4.1.2.1 Surface water sampling
    - 4.1.2.2 Groundwater sampling
  - *4.1.3 Sediment sampling*
  - *4.1.4 Air sampling*
  - *4.1.5 Fish tissue sampling*
  - *4.1.6 Monitoring well installation*
- 4.2 SAMPLING ORDER
- 4.3 SAMPLE QUANTITY
- 4.4 ANALYSES REQUESTED
- 4.5 SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS
- 4.6 CHAIN-OF-CUSTODY

5.0 DATA QUALITY

- 5.1 FIELD METHODS
- 5.2 FIELD DECONTAMINATION
- 5.3 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) SAMPLES
  - *5.3.1 Trip blank*
  - *5.3.2 Duplicate (co-located) samples*
  - *5.3.3 Replicate (split) samples*
  - *5.3.4 Equipment Rinsate blank samples*
  - *5.3.5 Field blank samples*

6.0 INVESTIGATION DERIVED WASTES (IDW) PLAN

7.0 SITE SAFETY

8.0 REPORTING

APPENDIXS

APPENDIX A - Site Map
APPENDIX B - Site Health & Safety Plan

APPENDIX 2: EXAMPLE SAMPLING PLAN AND REPORT OUTLINES

OUTLINE FOR SITE HEALTH AND SAFETY PLAN

1.0 INTRODUCTION

2.0 KEY PERSONNEL

3.0 SITE INFORMATION

- 3.1 OVERALL INCIDENT/RISK/HAZARD ANLYSIS
- 3.2 CONTAMINANT(S) OF CONCERN
  - *3.2.1 Pysical State and Chemcial Characteristics*
  - *3.2.2 Physical Hazards*
- 3.3 TASK SPECIFIC RISK ANALYSIS

4.0 MEDICAL SURVEILLANCE AND PERSONNEL TRAINING REQUIREMENTS

5.0 PERSONAL PROTECTIVE EQUIPMENT

6.0 FREQUENCY AND TYPE OF AIR MONITORING/SAMPLING

7.0 SITE CONTROL MEASURES

- 7.1 THE "BUDDY -SYSTEM"
- 7.2 SAFE WORK PRACTICES
- 7.3 SITE COMMUNICATIONS
- 7.4 WORK ZONES

8.0 DECONTAMINATION PROCEDURE/SOLUTIONS

9.0 EMERGENCY INFORMATION

10.0 ADDITIONAL EMERGENCY INFORMATION/NUMBERS

11.0 SIGNATURES

APPENDIX 2: EXAMPLE SAMPLING PLAN AND REPORT OUTLINES

OUTLINE FOR SAMPLING REPORT

1.0 INTRODUCTION

2.0 SITE INFORMATION

- 2.1 LOCATION
- 2.2 DESCRIPTION
- 2.3 HISTORY/CONTAMINANTS OF CONCERN

3.0 METHODS

- 3.1 FIELD PROCEDURES
  - *3.1.1 Soil sampling*
    - 3.1.1.1 Surface soil sampling
    - 3.1.1.2 Depth-discrete soil sampling
  - *3.1.2 Water sampling*
    - 3.1.2.1 Surface water sampling
    - 3.1.2.2 Groundwater sampling
      - 3.1.2.2.1 Residential well sampling
      - 3.1.2.2.1 Municipal well sampling
      - 3.1.2.2.1 Monitoring well sampling
      - 3.1.2.2.1 Temporary well sampling
  - *3.1.3 Sediment sampling*
  - *3.1.4 Air sampling*
  - *3.1.5 Fish tissue sampling*
  - *3.1.6 Monitoring well installation*
- 3.2 SAMPLING ORDER
- 3.3 SAMPLE QUANTITY
- 3.4 ANALYSES REQUESTED
- 3.5 CHAIN-OF-CUSTODY

4.0 DATA QUALITY

- 4.1 FIELD METHODS
- 4.2 FIELD DECONTAMINATION
- 4.3 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) SAMPLES
  - *4.3.1 Trip blank*
  - *4.3.2 Duplicate (co-located) samples*
  - *4.3.3 Replicate (split) samples*
  - *4.3.4 Equipment rinsate blank samples*
  - *4.3.5 Field blank*
- 4.4 QA/QC DATA INTERPRETATION
  - *4.4.1 Trip blanks*
  - *4.4.2 Equipment rinsate samples*
  - *4.4.3 Background samples*

5.0 INVESTIGATION DERIVED WASTES (IDW)

6.0 OBSERVATIONS

7.0 REPORTING

APPENDIXS

APPENDIX 2: EXAMPLE SAMPLING PLAN AND REPORT OUTLINES

OUTLINE FOR SAMPLING REPORT (CONT.)

TABLE 1 - Sample Listing/Analytes
TABLE 2 - Sample Description
TABLE 3 - Geographic Coordinates of Sample Locations
APPENDIX A - Site Maps
APPENDIX B - Chain-of-Custody Copies/Analytical Results
APPENDIX C - Photographs
APPENDIX D - Copies of Field Notes

APPENDIX 3: HOLDING TIMES, PRESERVATION, AND SAMPLE VOLUMES

AQUEOUS MATRICES					
Parameter	**Minimum Volume (mls)**	**Optimum Volume (mls)**	**Container Type**	**Preservative**	**Holding Time**
INORGANIC NONMETALLIC CONSTITUENTS					
Cyanide (CN), Total	100	1000	P,G	Cool, NaOH to pH > 12	14 days
Cyanide (CN), Amenable to Chlorination	250	1000	P,G	Cool, NaOH to pH > 12	14 days
METALLIC CONSTITUENTS					
Total Metals (As, Ba, Cd, Co, Cr, Cu, Fe, Mn, Pb, Ni, Ag, Zn, Al, Sb, Be, Se, Mg, Ca, Hg)	250	1000	P,G	Cool, HNO_3 to pH < 2	6 mos. 28 days for Hg
Dissolved Metals (As, Ba, Cd, Co, Cr, Cu, Fe, Mn, Pb, Ni, Ag, Zn, Al, Sb, Be, Se, Mg, Ca, Hg)	150	1000	P,G	Filter on-site Cool HNO_3 to pH < 2	6 mos. 28 days for Hg
Dissolved Hexavalent Cr	100	500	P,G	Filter on-site; none	24 hrs.
TCLP Metals (Ag, As, Ba, Cd, Cr, Pb, Se, Hg)	750	1000	P,G	Cool	6 mos.

APPENDIX 3: HOLDING TIMES, PRESERVATION, AND SAMPLE VOLUMES

AQUEOUS MATRICES					
Parameter	**Minimum Volume (mls)**	**Optimum Volume (mls)**	**Container Type**	**Preservative**	**Holding Time**
ORGANIC CONSTITUENTS					
Semivolatile Organic Compounds (SVOCs)	1000	3000	G	Cool	7 days to extract
Chlorophenoxy Acid Herbicides	1000	3000	G	Cool	7 days to extract
Organochlorine Pesticides & PCBs	1000	3000	G	Cool	7 days to extract
Volatile Organic Compounds (VOCs)	40 (1 vial)	120 (3 vials)	G	Cool, HC1 to pH < 2	14 days
Total Petroleum Hydrocarbon (8015/OA2)	1000	3000	G	Cool	7 days to extract
2,3,7,8 – Tetrachloro-dibenzo-P-Dioxins (TCDD)	1000	3000	G	Cool	30 days to extract

APPENDIX 3: HOLDING TIMES, PRESERVATION, AND SAMPLE VOLUMES

NON-AQUEOUS MATRICES					
Parameter	**Minimum Volume (fl oz, gm, or oz)**	**Optimum Volume (fl oz or gm)**	**Container Type**	**Preservative**	**Holding Time**
INORGANIC NONMETALLIC CONSTITUENTS					
Cyanide (CN), Total	8 fl.oz jar	8 fl oz jar	G	Cool	14 days
METALLIC CONSTITUENTS					
Total Metals (As, Ba, Cd, Co, Cr, Cu, Fe, Mn, Pb, Ni, Ag, Zn, Al, Sb, Be, Se, Mg, Ca, Hg)	100gm (~3oz)	8 fl oz jar	G	Cool	6 mos. 28 days for Hg
TCLP Metals (Ag, As, Ba, Cd, Cr, Pb, Se, Hg)	8 fl oz jar	(2) 8 fl oz jar	G	Cool	6 mos. 28 days for Hg
ORGANIC CONSTITUENTS					
Semi-volatile Organic Compounds (SVOCs)	50gm (~2oz)	8 fl oz jar	G	Cool	14 days to extract
TCLP SVOCs	8 fl oz jar	(2) 8 fl oz jar*	G	Cool	14 days to extract
Chlorophenoxy Acid Herbicides	50gm (~2oz)	(2) 8 fl oz jars	G	Cool	14 days to extract
TCLP Herbicides	8 fl oz jar	(2) 8 fl oz jar*	G	Cool	14 days to extract
Organochlorine Pesticides & PCBs	100gm (~4oz)	(2) 8 fl oz jars	G	Cool	14 days to

APPENDIX 3: HOLDING TIMES, PRESERVATION, AND SAMPLE VOLUMES

NON-AQUEOUS MATRICES					
Parameter	**Minimum Volume (fl oz, gm, or oz)**	**Optimum Volume (fl oz or gm)**	**Container Type**	**Preservative**	**Holding Time**
					extract
TCLP Pesticides	8 fl oz jar	(2) 8 fl oz jar*	G	Cool	14 days to extract
Volatile Organic Compounds (VOCs) (includes Total Petroleum Hydrocarbons 8015/OA1)	(1) 5gm Encore™ sample	(2) 5gm Encore™ samples**	E	Cool	14 days
TCLP VOCs	(1) 25gm Encore™ sample	(1) 25gm Encore™ samples**	E	Cool	14 days to extract
Total Petroleum Hydrocarbons (8015/OA2)	50gm (~2oz)	(1) 8 fl oz jar	G or E	Cool	7 days to extract
2,3,7,8 – Tetrachloro-dibenzo-P-Dioxins (TCDD)	50gm (~2oz)	8 fl oz jar	G	Cool	30 days to extract

* If total and TCLP organics are needed, a total of (2) 8fl oz jars per analyte group will be adequate to conduct both analyses

** Optimal volume on sample(s) collected for precision QC analysis (replicates and duplicates) will be (4) 5gm Encore™ samples and (2) 25 gm Encore™ samples.

APPENDIX 4: PARAMETER LISTS AND SAMPLE QUANTITATION LIMITS

Organochlorine Pesticides, Chlorophenoxy Acid Herbicides, and Polychlorinated Biphenyls			
Methods[1]	**Parameter**	**Water PQL ug/L**	**Soil PQL ug/Kg**
3510C or 3550B/8081A	Aldrin	0.13	5
3510C or 3550B/8081A	alpha-BHC	0.13	5
3510C or 3550B/8081A	beta-BHC	0.13	5
3510C or 3550B/8081A	gama-BHC (Lindane)	0.13	5
3510C or 3550B/8081A	delta-BHC	0.13	5
3510C or 3550B/8081A	Chlordane	1.3	50
3510C or 3550B/8081A	4,4'-DDE	0.13	5
3510C or 3550B/8081A	4,4'-DDD	0.13	5
3510C or 3550B/8081A	4,4'-DDT	0.13	5
3510C or 3550B/8081A	Dieldrin	0.13	5
3510C or 3550B/8081A	Endosulfan I	0.13	5
3510C or 3550B/8081A	Endosulfan II	0.13	5
3510C or 3550B/8081A	Endosulfan sulfate	0.13	5
3510C or 3550B/8081A	Endrin	0.13	5
3510C or 3550B/8081A	Endrin aldehyde	0.13	5
3510C or 3550B/8081A	Heptachlor	0.13	5
3510C or 3550B/8081A	Heptachlor Epoxide	0.13	5
3510C or 3550B/8081A	Methoxychlor	0.13	5
3510C or 3550B/8081A	Toxaphene	1.3	50
3510C or 3550B/EPA 515	2,4-D	5	100
3510C or 3550B/EPA 515	2,4,5-T	0.5	10
3510C or 3550B/EPA 515	2,4,5-TP (Silvex)	0.5	10
3510C or 3550B/EPA 515	Pentachlorophenol	0.5	NA
3510C or 3550B/8082	Polychlorinated Biphenyls (PCBs)[2]	0.5	50
1311/3510C/8081A	TCLP Pesticides[3]	1	NA
1311/3510C/EPA 515	TCLP Herbicides[3]	1	NA

1. Most Recent revision of *EPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, or Methods for the Determination of Organic Compounds in Drinking Water (EPA/600/4-88-039*).
2. Quantitated as total PCBs.
3. PQL is for each pesticide or herbicide listed in 40 CFR Part 261 Subpart C (261.24).

APPENDIX 4: PARAMETER LISTS AND SAMPLE QUANTITATION LIMITS

Volatile Organic Compounds (VOCs)			
Methods[1]	**Parameter**	**Water PQL ug/L**	**Soil PQL ug/Kg**
5030B or 5035/8260B	1,1,1,2-Tetrachloroethane	1	5
5030B or 5035/8260B	1,1,1-Trichloroethane	1	5
5030B or 5035/8260B	1,1,2,2-Tetrachloroethane	1	5
5030B or 5035/8260B	1,1,2-Trichloroethane	1	5
5030B or 5035/8260B	1,1-Dichloroethane	1	5
5030B or 5035/8260B	1,1-Dichloroethene	1	5
5030B or 5035/8260B	1,1-Dichloropropanone	2	10
5030B or 5035/8260B	1,1-Dichloropropene	1	5
5030B or 5035/8260B	1,2,3-Trichlorobenzene	5	25
5030B or 5035/8260B	1,2,3-Trichloropropane	1	5
5030B or 5035/8260B	1,2,4-Trichlorobenzene	5	25
5030B or 5035/8260B	1,2,4-Trimethylbenzene	1	5
5030B or 5035/8260B	1,2-Dibromoethane (EDB)	1	5
5030B or 5035/8260B	1,2-Dichlorobenzene	1	5
5030B or 5035/8260B	1,2-Dichloroethane	1	5
5030B or 5035/8260B	1,2-Dichloropropane	1	5
5030B or 5035/8260B	1,3,5-Trimethylbenzene	1	5
5030B or 5035/8260B	1,3-Dichlorobenzene	1	5
5030B or 5035/8260B	1,3-Dichloropropane	1	5
5030B or 5035/8260B	1,4-Dichlorobenzene	1	5
5030B or 5035/8260B	1.2-Dibromo-3-chloropropane	1	5
5030B or 5035/8260B	1-Chorobutane	1	5
5030B or 5035/8260B	2,2-Dichloropropane	1	5
5030B or 5035/8260B	2-Butanone (MEK)	5	25
5030B or 5035/8260B	2-Chlorotoluene	1	5
5030B or 5035/8260B	2-Hexanone	2	10
5030B or 5035/8260B	2-Nitropropane	1	5
5030B or 5035/8260B	4-Chlorotoluene	1	5
5030B or 5035/8260B	4-Methyl-2-pentanone(MIBK)	1	5
5030B or 5035/8260B	Acetone	20	100
5030B or 5035/8260B	Acrylonitrile	2	10
5030B or 5035/8260B	Allyl Chloride	1	5
5030B or 5035/8260B	Benzene	1	5
5030B or 5035/8260B	Bromobenzene	1	5
5030B or 5035/8260B	Bromochloromethane	1	5
5030B or 5035/8260B	Bromodichloromethane	1	5
5030B or 5035/8260B	Bromoform	1	5
5030B or 5035/8260B	Bromomethane	5	25
5030B or 5035/8260B	Carbon disulfide	1	5
5030B or 5035/8260B	Carbon Tetrachloride	1	5
5030B or 5035/8260B	Chloroacetonitrile	25	125
5030B or 5035/8260B	Chlorobenzene	1	5
5030B or 5035/8260B	Chloroethane[2]	5	25
5030B or 5035/8260B	Chloroform	1	5
5030B or 5035/8260B	Chloromethane[2]	25	125
5030B or 5035/8260B	cis-1,2-dichloroethene	1	5
5030B or 5035/8260B	cis-1,3-Dichloropropene	1	5
5030B or 5035/8260B	Dibromochloromethane	1	5
5030B or 5035/8260B	Dibromomethane	1	5
5030B or 5035/8260B	Dichlorodifluoromethane	1	5
5030B or 5035/8260B	Diethyl ether	20	100

APPENDIX 4: PARAMETER LISTS AND SAMPLE QUANTITATION LIMITS

Volatile Organic Compounds (VOCs)			
Methods[1]	**Parameter**	**Water PQL ug/L**	**Soil PQL ug/Kg**
5030B or 5035/8260B	Ethylbenzene	1	5
5030B or 5035/8260B	Ethylmethacrylate	1	5
5030B or 5035/8260B	Hexachlorobutadiene	2	10
5030B or 5035/8260B	Hexachloroethane	1	5
5030B or 5035/8260B	Iodomethane	5	25
5030B or 5035/8260B	Isopropylbenzene	1	5
5030B or 5035/8260B	m,p-xylene	1	5
5030B or 5035/8260B	Methacrylonitrile	1	5
5030B or 5035/8260B	Methyl Acrylate	10	50
5030B or 5035/8260B	Methylene chloride[2]	20	100
5030B or 5035/8260B	Methylmethacrylate	1	5
5030B or 5035/8260B	Methyl-t-butyl ether	1	5
5030B or 5035/8260B	Naphthalene	5	25
5030B or 5035/8260B	n-Butylbenzene	1	5
5030B or 5035/8260B	Nitrobenzene	10	50
5030B or 5035/8260B	n-Propylbenzene	1	5
5030B or 5035/8260B	o-Xylene	1	5
5030B or 5035/8260B	Pentachloroethane	1	5
5030B or 5035/8260B	p-isopropyltoluene	1	5
5030B or 5035/8260B	Propionitrile	20	100
5030B or 5035/8260B	sec-Butylbenzene	1	5
5030B or 5035/8260B	Styrene	1	5
5030B or 5035/8260B	tert-Butylbenzene	2	10
5030B or 5035/8260B	Tetrachloroethene	1	5
5030B or 5035/8260B	Tetrahydrofuran	5	25
5030B or 5035/8260B	Toluene	1	5
5030B or 5035/8260B	Total Xylenes	2	10
5030B or 5035/8260B	trans-1,2-Dichloroethene	1	5
5030B or 5035/8260B	trans-1,3-Dichloropropene	1	5
5030B or 5035/8260B	trans-1,4-Dichloro-2-butene	1	5
5030B or 5035/8260B	Trichloroethene	1	5
5030B or 5035/8260B	Trichloroflouromethane	5	25
5030B or 5035/8260B	Vinyl Chloride	1	5
1311/5030B/8260B	TCLP VOCs[3]	40	NA

1. Most Recent revision of *EPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.*
2. A lower PQL may be needed for this analyte on specific projects covered by this QAPP. Arrangements will be made with ESP CAS in advance of sampling to take special analytical precautions or to subcontract analysis.
3. PQL listed is for each volatile organic compound listed in 40 CFR Part 261 Subpart C (261.24).

APPENDIX 4: PARAMETER LISTS AND SAMPLE QUANTIATION LIMITS

Semivolatile Organic Compounds (SVOCs)			
Methods[1]	**Parameter**	**Water PQL ug/L**	**Soil PQL ug/Kg**
3510C or 3550B/8270C	1,2,4-Trichlorobenzene	5	100
3510C or 3550B/8270C	1,2-Dichlorobenzene	5	100
3510C or 3550B/8270C	1,3-Dichlorobenzene	5	100
3510C or 3550B/8270C	1,4-Dichlorobenzene	5	100
3510C or 3550B/8270C	2,4,5-Trichlorophenol	20	400
3510C or 3550B/8270C	2,4,6-Trichlorophenol	5	100
3510C or 3550B/8270C	2,4-Dichlorophenol	5	100
3510C or 3550B/8270C	2,4-Dimethylphenol	5	100
3510C or 3550B/8270C	2,4-Dinitrophenol	20	400
3510C or 3550B/8270C	2,4-Dinitrotoluene	5	100
3510C or 3550B/8270C	2,6-Dinitrotoluene	5	100
3510C or 3550B/8270C	2-Chloronaphthalene	5	100
3510C or 3550B/8270C	2-Chlorophenol	20	400
3510C or 3550B/8270C	2-Methyl-4,6-dinitrophenol	20	400
3510C or 3550B/8270C	2-Methylnaphthalene	5	100
3510C or 3550B/8270C	2-Methylphenol	5	100
3510C or 3550B/8270C	2-Nitroaniline	20	400
3510C or 3550B/8270C	2-Nitrophenol	5	100
3510C or 3550B/8270C	3,3'-Dichlorobenzidine	20	400
3510C or 3550B/8270C	3-Nitroaniline	20	400
3510C or 3550B/8270C	4-Bromophenyl phenyl ether	5	100
3510C or 3550B/8270C	4-Chloro-3-methylphenol	20	400
3510C or 3550B/8270C	4-Chloroaniline	20	400
3510C or 3550B/8270C	4-Chlorophenyl phenyl ether	5	100
3510C or 3550B/8270C	4-Methylphenol	5	100
3510C or 3550B/8270C	4-Nitroaniline	20	400
3510C or 3550B/8270C	4-Nitrophenol	20	400
3510C or 3550B/8270C	Acenaphthene	5	100
3510C or 3550B/8270C	Acenaphthylene	5	100
3510C or 3550B/8270C	Anthracene	5	100
3510C or 3550B/8270C	Azobenzene	5	100
3510C or 3550B/8270C	Benzo(a)anthracene	5	100
3510C or 3550B/8270C	Benzo(a)pyrene	5	100
3510C or 3550B/8270C	Benzo(b)fluoranthene	5	100
3510C or 3550B/8270C	Benzo(ghi)perylene	5	100
3510C or 3550B/8270C	Benzo(k)fluoranthene	5	100
3510C or 3550B/8270C	Benzoic Acid	5	100
3510C or 3550B/8270C	bis(2-Chloroethoxy)methane	5	100
3510C or 3550B/8270C	bis(2-Chloroethyl)ether	5	100
3510C or 3550B/8270C	bis(2-chloroisopropyl)ether	5	100
3510C or 3550B/8270C	bis(2-Ethylhexyl) phthalate	5	100
3510C or 3550B/8270C	Butyl benzyl phthalate	5	100
3510C or 3550B/8270C	Chrysene	5	100
3510C or 3550B/8270C	Dibenzo(a,h)anthracene	5	100
3510C or 3550B/8270C	Dibenzofuran	5	100
3510C or 3550B/8270C	Diethyl phthalate	5	100
3510C or 3550B/8270C	Dimethyl phthalate	5	100
3510C or 3550B/8270C	Di-n-butyl phthalate	5	100
3510C or 3550B/8270C	Di-n-octyl phthalate	5	100
3510C or 3550B/8270C	Fluoranthene	5	100
3510C or 3550B/8270C	Fluorene	5	100

APPENDIX 4: PARAMETER LISTS AND SAMPLE QUANTIATION LIMITS

Semivolatile Organic Compounds (SVOCs)			
Methods[1]	**Parameter**	**Water PQL ug/L**	**Soil PQL ug/Kg**
3510C or 3550B/8270C	Hexachlorobenzene	5	100
3510C or 3550B/8270C	Hexachlorobutadiene	5	100
3510C or 3550B/8270C	Hexachlorocyclopentadiene	5	100
3510C or 3550B/8270C	Hexachloroethane	5	100
3510C or 3550B/8270C	Indeno(1,2,3-cd)pyrene	5	100
3510C or 3550B/8270C	Isophorone	5	100
3510C or 3550B/8270C	Naphthalene	5	100
3510C or 3550B/8270C	Nitrobenzene	5	100
3510C or 3550B/8270C	n-Nitroso-di-n-propylamine	5	100
3510C or 3550B/8270C	n-Nitrosodiphenylamine	5	100
3510C or 3550B/8270C	Pentachlorophenol[2]	20	400
3510C or 3550B/8270C	Phenanthrene	5	100
3510C or 3550B/8270C	Phenol	5	100
3510C or 3550B/8270C	Pyrene	5	100
3510C or 3550B/8310	Acenaphthene	18	NA
3510C or 3550B/8310	Acenaphthylene	23	NA
3510C or 3550B/8310	Anthracene	7	NA
3510C or 3550B/8310	Benzo(a)anthracene	0.1	NA
3510C or 3550B/8310	Benzo(a)pyrene	0.2	NA
3510C or 3550B/8310	Benzo(b)fluoranthene	0.2	NA
3510C or 3550B/8310	Benzo(ghi)perylene	0.8	NA
3510C or 3550B/8310	Benzo(k)fluoranthene	0.2	NA
3510C or 3550B/8310	Chrysene	2	NA
3510C or 3550B/8310	Dibenzo(a,h)anthracene	0.3	NA
3510C or 3550B/8310	Fluoranthene	2	NA
3510C or 3550B/8310	Fluorene	2	NA
3510C or 3550B/8310	Indeno(1,2,3-cd)pyrene	0.4	NA
3510C or 3550B/8310	Naphthalene	18	NA
3510C or 3550B/8310	Phenanthrene	6	NA
3510C or 3550B/8310	Pyrene	3	NA
1311/3510C/8270	TCLP Semi-VOCs[3]	25	NA
3510C or 3550B/8280A or 8290	Polychlorinated Dibenzo-ρ-Dioxins and Furans[4]	3E-05	1
8015/OA2	Total Petroleum Hydrocarbons (TPH)	5,000	100,000

1. EPA SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, most recent revision.
2. Pentachlorophenol may also be analyzed by EPA Method 515 where a lower water PQL is required (see first table in this appendix)
3. PQL listed is for each semi-volatile organic compound listed in 40 CFR Part 261 Subpart C (261.24).
4. Congener-specific analysis summarized as 2,3,7,8-TCDD total toxicity equivalents.

APPENDIX 4: PARAMETER LISTS AND SAMPLE QUANTITATION LIMITS

Metals and Cyanide				
Methods[1]	**Parameter**	**Water PQL ug/L**	**Soil/Sed. PQL ug/Kg**	**TCLP Extract PQL mg/L**
200.7/200.9	Antimony	1.0	500	NA
200.7/200.9	Arsenic[2]	1.0	2000	0.100
200.7/200.9	Barium[2]	1.0	500	0.010
200.7/200.9	Beryllium	1.0	500	NA
200.7/200.9	Cadmium[2]	1.0	500	0.010
200.7/200.9	Chromium[2]	5	1000	0.010
200.7/200.9	Copper	10	5000	NA
Lachat 10-124-13-1-A	Hexavalent Chromium	10	NA	NA
200.7/200.9	Lead[2]	4.0	2000	0.100
245.1	Mercury[2]	0.20	40	0.0002
200.7/200.9	Nickel	10	5000	NA
200.7/200.9	Selenium[2]	1.0	2000	0.100
200.7/200.9	Silver[2]	5.0	2000	0.010
200.7/200.9	Thallium	1.0	500	NA
200.7/200.9	Vanadium	10	5000	NA
200.7/200.9	Zinc	10	5000	NA
335.4	Cyanide	10	NA	NA

1. Most recent revision of *EPA Methods for the Determination of Metals in Environmental Samples Supplement* (EPA/600/R-94/111) unless otherwise noted.
2. Included in list of eight RCRA metals.

APPENDIX 5: STANDARD OPERATING PROCEDURES LIST

Environmental Services Program

Field Services Section

MDNR-FSS-001	Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations
MDNR-FSS-002	Field Sheet and Chain of Custody Record
MDNR-FSS-003	Sample Numbering and Labeling
MDNR-FSS-004	Field Documentation
MDNR-FSS-005	General Sampling Considerations Including the Collection of Grab, Composite, and Modified Composite Samples from Streams and Wastewater Flows
MDNR-FSS-006A	Sampling Water and Other Liquids for Volatile Organic Analysis (VOA)
MDNR-FSS-006B	Sampling Soils and Other Solid Media for Volatile Organic Analysis (VOA)
MDNR-FSS-007	Collection of Samples From Wells
MDNR-FSS-008	Collection of Samples From Drums
MDNR-FSS-009	Collection of Samples From Tanks
MDNR-FSS-010	Collection of Soil Samples
MDNR-FSS-011	General Sampling Considerations for Sediments
MDNR-FSS-018	Sample Handling; Field Handling, Transportation and Delivery to the ESP Lab
MDNR-FSS-100	Field Analysis of Water Samples for pH
MDNR-FSS-101	Field Measurement of Water Temperatures
MDNR-FSS-102	Field Analysis of Specific Conductance
MDNR-FSS-106	Field Analysis of Flash Point
MDNR-FSS-206	Decontamination Procedures for Sampling Equipment
MDNR-FSS-210	Quality Assurance/Quality Control for Environmental Data Collection
MDNR-FSS-211	Quality Assurance Field Auditing Procedures

Chemical Analysis Section

MDNR-CAS-2000*	Chain of Custody-Review and Correction
MDNR-CAS-2005*	Sample Numbering and Tagging
MDNR-CAS-2010*	Contract Lab Sample Analysis and Contract Lab Data Review
MDNR-CAS-2020*	Data Review, Reduction and Transfer to LIMS
MDNR-CAS-2030*	Employee Proficiency Documentation
MDNR-CAS-2040	Instrument Maintenance
MDNR-CAS-2050*	Laboratory Safety

MDNR-CAS-2060*	MDLs and PQLs
MDNR-CAS-2070*	Method Validation
MDNR-CAS-2080*	On-site Evaluation of a Laboratory as Part of the Certification Process
MDNR-CAS-2090*	Quality Control Charts
MDNR-CAS-2100*	Quality Control Procedures
MDNR-CAS-2120	Sample Prioritization in the CAS
MDNR-CAS-2130	Sample Receipt, Storage and Disposal
MDNR-CAS-2140	Supplies Procurement, Inspection and Acceptance
MDNR-CAS-2200*	Digestion for Total Metals in Soil or Sludge
MDNR-CAS-2210*	Digestion for Total Metals in Water or Wastewater
MDNR-CAS-2220*	Digestion for Total Metals on Air Filters
MDNR-CAS-2230	Digestion for Total Recoverable Metals in Water
MDNR-CAS-2235	Turbidity
MDNR-CAS-2240*	Analysis of Samples for Mercury
MDNR-CAS-2250*	Ion Chromatography, Operation and Analysis
MDNR-CAS-2260	ICP, Operation and Analysis
MDNR-CAS-2270*	4100 GFAA, Operation and Analysis
MDNR-CAS-2280	5000 GFAA, Operation and Analysis
MDNR-CAS-2290*	TCLP Extraction for Metals and Semi-Volatile Organics
MDNR-CAS-2450	Lachet, Operation and Analysis
MDNR-CAS-2460	pH
MDNR-CAS-2480	Specific Conductivity
MDNR-CAS-2490*	Total Dissolved Solids (TDS)
MDNR-CAS-2500	Volatile Suspended Solids (VSS)
MDNR-CAS-2600*	Analysis of Base Neutral and Acid Extractable Semi-Volatile Organics by GC/MS
MDNR-CAS-2610	Analysis of Drinking Water for Carbamate Pesticides
MDNR-CAS-2620	Analysis of Drinking Water for Haloacetic Acids
MDNR-CAS-2625	Analysis of PCB's on Swabs
MDNR-CAS-2630	Analysis of Environmental Samples for PCBs
MDNR-CAS-2635	PCB's in Soil using SFE Extraction and GC
MDNR-CAS-2640	Analysis of Pesticides in Soil/Sludge
MDNR-CAS-2645	Organochlorine Pesticides and PCB's in an Organic Matrix Using Solvent Dilution and GC
MDNR-CAS-2650	Analysis of Pesticides in Water/Wastewater
MDNR-CAS-2660*	OA2-Analysis of Total Petroleum Hydrocarbons by Fingerprint Analysis
MDNR-CAS-2670*	Analysis of Volatile Organics by GC/MS
MDNR-CAS-2680*	Analysis of Volatile Organics in Drinking Water by Gas Chromatography

APPENDIX 5: STANDARD OPERATING PROCEDURES LIST

MDNR-CAS-2690	Chlorinated Acid Herbicides in Water
MDNR-CAS-2695	Analysis of Chlorinated Acid Herbicides in Soil/Sludge
MDNR-CAS-2696	Analysis of Chlorinated Acid Herbicides in Non-Potable Water
MDNR-CAS-2700*	Flashpoint
MDNR-CAS-2720*	TCLP Extraction for Volatile Organics
MDNR-CAS-2740*	Tentative Identification of Compounds by GC/MS

Hazardous Waste Program

Superfund Section, Site Assessment Unit

MDNR-SAU-100	Writing Pre-CERCLIS Site Screening Reports
MDNR-SAU-101*	Writing Site Assessment Reports
MDNR-SAU-102*	Formatting Site Assessment Reports
MDNR-SAU-103*	Creating Site Maps
MDNR-SAU-104	Creating an Analytical Data Table
MDNR-SAU-107*	Obtaining Information for Site Assessment Investigations
MDNR-SAU-200*	Completing the Desk Top Review Form
MDNR-SAU-201*	Completing the Pre-CERCLIS Site Initiation Form
MDNR-SAU-202	Completing the Pre-CERCLIS Site Screening Form
MDNR-SAU-203*	Completing Preliminary Assessment Scoresheets
MDNR-SAU-204*	Completing Site Investigation Scoresheets
MDNR-SAU-205*	Completing the Removal Site Evaluation Form
MDNR-SAU-300*	Operation of Trimble GPS Receiver
MDNR-SAU-301*	Operation of Portable X-Ray Fluorescence (XRF) Analyzers
MDNR-SAU-302	Operating Digital Cameras
MDNR-SAU-303*	Operating 35mm Cameras
MDNR-SAU-400*	Documenting Field Notes
MDNR-SAU-401	Naming Sites
MDNR-SAU-402*	Entry of Site Data into the Site Management and Reporting System Database (SMARS)
MDNR-SAU-403*	Filing Procedures
MDNR-SAU-404*	Electronic File Management
MDNR-SAU-405*	Requesting an Missouri Department of Conservation (MDC) Ecological Review

* SOP is planned, but has not been written as of the date of this QAPP revision.

APPENDIX 6: LABORATORY ANALYTICAL DATA QUALIFIERS

Data Qualifier	Explanation
1	Improper collection method
2	Improper preservation
3	Exceeded holding time
4	Estimated value; detected below the PQL
5	Estimated value; quality control data outside limits
6	Estimated value; analyte outside calibration range
7	Analyte present in blank at > ½ reported value
8	Sample was diluted during analysis
9	Laboratory error
10	Estimated value; matrix interference
12	Insufficient sample quantity
13	Estimated value; true result is > reported value
14	Estimated value; non-homogenous sample
15	No result; failed quality control requirements
ND	Not detected at reported value

APPENDIX 7: ACRONYM LISTING

ALPD	Air and Land Protection Division
CAS	Chemical Analysis Section
CERCLA	Comprehensive Environmental Response Compensation & Liability Act
CERCLIS	CERCLA Information System
COC	Chain of Custody
CSM	Conceptual Site Model
DQA	Data Quality Assessment
DQO	Data Quality Objective
DTR	Desktop Review
EPA	Environmental Protection Agency
ES	Environmental Specialist
ESI	Expanded Site Inspection
ESP	Environmental Services Program
FSS	Field Services Section
FTE	Full Time Employee
GC/MS	Gas Chromatrography/Mass Spectrometry
GIS	Geographic Information System
GPS	Global Positioning System
GSRAD	Geological Survey and Resource Assessment Division
HAZWOPER	Hazardous Waste Operations and Emergency Response
HRS	Hazard Ranking System
HWP	Hazardous Waste Program
LIMS	Laboratory Information Management System
LMAD	Locational Data Method Accuracy Description
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDL	Method Detection Limit
MDNR	Missouri Department of Natural Resources
MIP	Membrane Interface Probe
MRBCA	Missouri Risk Based Corrective Action
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NELAC	National Environmental Laboratory Accreditation Conference
NFRAP	No Further Remedial Action Planned
NIST	National Institute of Standards and Technology
NPL	National Priorities List
PA	Preliminary Assessment
PA/RA	Preliminary Assessment/Removal Assessment
PA/SI	Preliminary Assessment/Site Inspection
PA/SI/RA	Preliminary Assessment/Site Inspection/Removal Assessment
PAH	Polynuclear Aromatic Hydrocarbons
PQL	Practical Quantitation Limit
PQL	Sample Quantitation Limit
PRG	Preliminary Remediation Goals
PRP	Potentially Responsible Party
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
RA	Removal Assessment
RCRA	Resource Conservation Recovery Act
RFP	Request for Proposal

APPENDIX 7: ACRONYM LISTING

RPD	Relative Percent Difference
SARA	Superfund Reauthorization Act
SAU	Site Assessment Unit
SCDM	Superfund Chemical Data Matrix
SI	Site Inspection
SI/RA	Site Inspection/Removal Assessment
SOP	Standard Operating Procedure
SR	Site Reassessment
SS	Pre-CERCLIS Site Screening
SVOC	Semi-Volatile Organic Compound
TCLP	Toxicity Characteristic Leachate Procedure
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
WQS	Water Quality Standards
XRF	X-Ray Fluorescence